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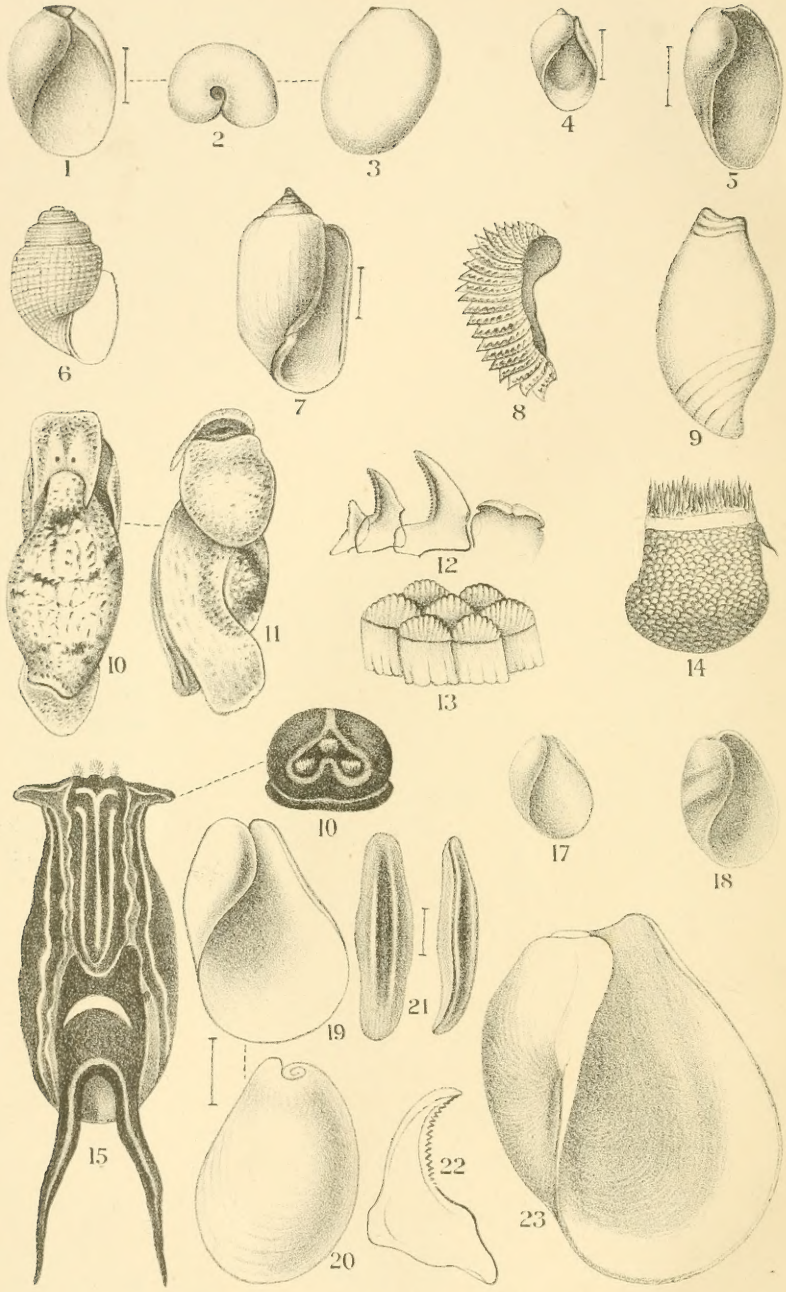

MANUAL

OF

CONCHOLOGY;

STRUCTURAL AND SYSTEMATIC.

WITH ILLUSTRATIONS OF THE SPECIES.

BY GEORGE W. TRYON, JR.

CONTINUATION BY

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Vol. XVI.

PHILINIDÆ, GASTROPTERIDÆ, AGLAJIDÆ, APLYSIIDÆ, OXYNOEIDÆ, RUNCINIDÆ, UMBRACULIDÆ, PLEUROBRANCHIDÆ.

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THE present volume is devoted to the monographs of Tectibranchiate mollusks, in continuation of Volume XV. The CEPHALASPIDEA herein monographed belong to groups of which but few species are represented in the collection studied, so that little beyond the merits of a careful compilation can be expected. In the ANASPIDEA, more material has been available, and it is hoped that progress has been made in the classification and definition of subfamilies and genera, as well as in the facilitation of specific determinations. To a less extent this also applies to the NOTASPIDEA.

A single family of ASCOGLOSSA, *Oxynoeidæ*, is included herein, on account of the Bulla-like shell developed. The other ASCOGLOSSA and the NUDIBRANCHIATA proper, which have no shells when adult, will not be included; the fruitful labors of Bergh rendering their treatment here inadvisable, especially in view of the fact that few conchologists concern themselves with those groups.

In an appendix, the Tectibranch groups of Volume XV are brought up to 1896.

A brief introductory chapter embodies the views of the author on the classification of CEPHALASPIDEA; the chief departures from previous arrangements being in the dismemberment of the old family *Bullidæ*, with the creation of *Akeratidæ;* and the rearrangement of the families into phyla based largely upon the mode of specialization of the radula, and the development of the pleuropodial lobes.

H. A. P.

CLASSIFICATION AND PHYLOGENY OF TECTIBRANCHIATA.

The Tectibranchiate mollusks have been divided by Dr. Paul Fischer into three main groups, based largely upon external anatomy:

I. Head bearing a fleshy shield; tentacles or rhinophores (as such) usually wanting; male organ or its orifice widely separated from the female orifice. CEPHALASPIDEA.

II. Head without shield, bearing a pair of enrolled, erect rhinophores, with usually an anterior pair of labial tentacular processes; gill dorsal; male and female orifices widely separated. ANASPIDEA.

III. No head shield; back protected by a fleshy shield or mantle, the gill below it on the right side; male and female orifices contiguous or not widely separated. NOTASPIDEA.

The families of *Cephalaspidea* are defined below. The group *Anaspidea* contains but one family, *Aplysiidæ* (see page 59). The families of *Notaspidea*, three in number, are defined on page 170 of this volume.

The numerous families of *Cephalaspidea*, or shield-headed Tectibranchs, fall into four well-defined groups or series, of about equal rank, as follows:

Operculate.

I. Radula multidentate; no pleuropodial lobes, *Actæonidæ*, Vol. XV, p. 135.

Not operculate.

II. Radula multidentate; pleuropodial lobes developed.

a. Head-shield without tentacles; shell thin, light yellow, brown or green; aperture frequently with a posterior sinus or slit at the suture, *Akeratidæ*, Vol. XV, p. 350.

aa. Head-shield bearing 2 or 4 tentacles; shell decidedly variegated; no posterior slit, *Hydatinidæ*, Vol. XV, p. 385.

III. Radula with few teeth in a row, or none. No pleuropodial lobes.

a. Shell oval, solid, mottled and variegated (except in a few deep water forms), spire umbilicated or concealed; radula formula 1.2.1.2.1, the rachidian tooth largest; 3 corneous, dumb-bell shaped stomach-plates,
Bullidæ, Vol. XV, p. 326.

aa. Shell small, unicolored; no teeth; 3 flat, oval, stomach-plates with coarsely tuberculate inner faces,
Tornatinidæ, Vol. XV, p. 180.

IV. Radula with few teeth in a row, or none; pleuropodial lobes well-developed or very large (? except in *Ringiculidæ*); shell often concealed and partly uncoiled or degenerate.

a. Shell obese, ovate, small, with thick outer lip and plicate columella (pleuropodial lobes wanting?),
Ringiculidæ, Vol. XV, p. 393.

aa. Shell few-whorled or degenerate, if spiral the aperture very large, as long as the shell. Pleuropodial lobes large.

b. Shell external to mantle,
Scaphandridæ, Vol. XV, p. 242.

bb. Shell wholly concealed in the mantle; no rachidian teeth.

c. Radula present; shell spiral, more or less open, wholly calcified; pleuropodia of moderate size, *Philinidæ*, p. 1.

cc. Radula present; shell reduced to a minute nautiloid calcareous spire and a large, open cuticular body-whorl; pleuropodia extremely large, *Gastropteridæ*, p. 39.

ccc. No teeth; shell a flattened open spiral; head and back shields subequal, the pleuropodia reflexed partly over them,
Aglajidæ, p. 43.

The accompanying diagram expresses the general relationships of the families of *Cephalaspidea*, as understood by the writer.

Approximate phylogeny of the families of Cephalaspidea.

The group of families on the left side are the most primitive of recent *Tectibranchiata*; the median and right hand groups being far more specialized, and more remote from the *Notaspidea* and *Anaspidea*.

A phylogenetic table of the shell-bearing Opisthobranchs has been given by M. Cossmann in a work of great merit, "Essais de Paléoconchyliologie Comparée" (1895), derived mainly from his studies of the fossil forms. The great discrepancy between the results obtained by the distinguished French author and myself, are in part traceable to the widely different material studied, and in part to the fact that Tectibranchs, like Pulmonates, are singularly non-committal in the characters of the *shell*. In fact, I feel that it is not extreme to state that *the shells alone*, in either group, are totally inadequate to express the affinities of families and genera. In so many groups are the shells more or less degenerate, so many are the cases of parallel or converging development of the shells, that conclusions based upon them alone, without a knowledge of the soft anatomy for a primary guide, are practically valueless for the appreciation of the affinities of genera and families, either in Tectibranchiata or Pulmonata. There can be no doubt, however, that palæontology will prove of great value in supplementing the evidence of comparative anatomy; and the best results can only be obtained by a union of the two methods.

Family PHILINIDÆ.

Philinidæ Fischer, Man. de Conch. p. 563.

Shell capable of containing but a small part of the body, entirely internal, covered by the reflexed and united mantle; whitish, fragile, open from in front or below, consisting of 2 to 1 whorls; spire sunken or absent; aperture extremely large, the outer lip often produced in a lobe or point above.

Body oblong, the head-shield having no tentacular processes, provided with sessile eyes or without them; foot truncated or rounded behind; parapodial lobes very large and conspicuous, more or less folded over the back.

Radula lacking central teeth; laterals large, uncini few or none. Formula varying from 6·1·0·1·6 to 1·0·1.

The family *Philinidæ* is most nearly allied to *Scaphandridæ*, but differs in having the mantle reflexed and closed over the shell, in lacking rhachidian teeth, and in the degeneration of the shell as a protective armor.

Synopsis of Genera.

Genus PHILINE Ascanius.

Shell spiral and moderately developed; foot about two-thirds the length of body, obliquely truncated.

Genus? PHILINOPSIS Pease.

The characters given by Pease are quite insufficient to show the position of the group. It may belong to *Aglajidæ*, which see.

Genus CHELIDONURA A. Ad.

Shell small, rudimentary, uncoiled; foot long, rounded behind; epipodial lobes long; mantle with two tail-like appendages; head with three groups of bristle-bearing tubes.

Genus CRYPTOPHTHALMUS Ehrenb.

Shell small, rudimentary, uncoiled; foot as long as body, rounded behind; parapodial lobes large, as long as foot; mantle without tail-like appendages; head lacking bristle-like sense-organs.

Genus PHILINE Ascanius, 1772.

Philine Ascanius, K. Vet. Ak. Stock. Handl. 1772, p. 329. —*Bullæa* Lam., Syst. Anim. s. Vert. p. 63, type *B. planciana* Lam., = *P. aperta* L. (1801).—*Lobaria* Muller, Zoologiæ Danicæ Prodromus, p. 226 (1776).—*Utriculopsis* M. Sars, Nyt. Mag. f. Naturvidens., 1870, xvii, p. 177 (see p. 16).—*Colpodaspis* M. Sars, Bidr. Kundskab. Christianiafjordens Fauna, ii, p. 74 (1870).—*Colobocephalus* M. Sars, *t. c.*, p. 54, type *C. costellatus* M. Sars, pl. 11, f. 7–14.—*Ossiania* Monts., Nom. Gen. e Spec. p. 147, type *P. quadrata* S. Wood (1884).—*Hermania* Monts., *l. c.*, type *P. scabra* Müll. —*Phyline* and *Philina* of some writers.

†*Laona* A. Ad., *Johania* Monts. and *Megistostoma* Gabb.

Shell ovate or squarish, thin and fragile, smooth, spirally striate or punctate, or latticed, translucent, pale colored; consisting of few loosely convoluted whorls, which are entirely open from below; spire sunken; aperture very large, broadly effuse below, the outer lip retracted joining a wide sinus above. Columella thin, arcuate, type *P. aperta* L.

Animal much too large to be included in the shell. Head disk oblong, large, without eyes: parapodial lobes fleshy and erect; foot obliquely truncated behind, the shell and mantle projecting beyond it. Mantle reflexed and completely united over the shell. (Pl. 3, figs. 53, 54, *P. aperta*; pl. 4, figs. 77, 78, *P. pruinosa*). Gizzard (pl. 9, figs. 6 from above, 7 lateral view) containing three lozenge-shaped plates, with the inner face convex, outer face concave and pierced by two foramina (pl. 9, f. 1–3, *P. aperta*). Sometimes gizzard-plates are rudimentary or absent.

Radula without rhachidian teeth, the laterals large, erect, claw-shaped; uncini 0 to 6, small, narrow, and curved acicular when present (pl. 9, figs. 4, 5 *P. aperta*; fig. 10, *P. pruinosa*).

The names *Lobaria* and *Bullæa* are absolute synonyms, being founded upon the type species of *Philine*. *Utriculopsis*, *Colpodaspis* and *Colobocephalus* were based upon the young of various species of *Philine*, although I believe that the last-named has not been identified as yet with any adult form. The dentition of *Colobocephalus* as figured by the younger Sars (see pl. 9, fig. 8) agrees well with that of *Philine*.

Sometus Férussac (Tab. Syst. p. xxx) and Blainville (Malacologie, p. 478), *Sormet* of Adanson, has sometimes been placed in the

synonymy of *Philine,* but a reference to Adanson's work shows it to be a doubtful synonym and practically useless.

G. O. Sars has proposed an arrangement of the *Scandinavian* Philines based upon the nature of the gizzard-plates, which may be calcified or cartilaginous, and the presence and number of uncini; and his scheme forms an admirable basis for the classification of the entire genus. Monterosato proposes several sectional groups based on shell contour and sculpture, but as these features change gradually as we pass from one species to another, the names he gives are hardly worth retaining. If sectional names are required the following scheme may serve until a study of the anatomy of all the species still unexamined, gives ground for a natural classification.

Section PHILINE *s. str.*

Shell smooth or with spiral striæ or dot-series; type *P. aperta.* Includes *Hermania* Monts., type *P. scabra; Ossiania* Monts., type *P. quadrata* Wood; *Megistostoma* Gabb, type *P. striata* Gabb not Desh.,=*P. gabbi* Cossm. (Cretaceous).

Section LAONA A. Adams.

Shell with latticed sculpture. Contains at present two species only: *P. pruinosa* Clark and *P. zonata* A. Ad.

Section JOHANIA Monts.

Shell with an external pumice-like reticulated layer. Type *P. vestita* Phil. No other species are known to belong to this group.

* * *

Subgenus PHILINE Ascanius.

I have above expressed the opinion that the sections *Hermania* and *Ossiania* are no aid to a right comprehension of the internal relationships of this genus. As to *Megistostoma,* the type specimen before me shows no departure of value from typical *Philine,* except that the sculpture is not quite like that of any recent species. The evidence of a thick inner lip is most unsatisfactory; the posterior lobe of the lip is more produced than in the average *P. aperta,* but probably not more than extreme forms of that species. It is broken off in the type, and so appears more rounded than it really was.

The following table is slightly modified from Sars. It is much to be desired that those species not yet sufficiently known to be inserted herein, be examined and their positions indicated.

Partial Key to Species of Philine.

a. Gizzard-plates distinct, calcareous.
b. Uncini 1 on each side, rudimentary; shell spirally chain-striate, oblong: *scabra, catena, loveni.*
bb. No uncini; shell wider.
c. Shell spirally striolate.
d. Striate delicate, wavy, close: *finmarchica, ossiansarsi, fragilis, japonica.*
dd. Striæ thick, opaque: *cingulata.*
cc. Very smooth; no spiral striæ: *aperta, infortunata.*
aa. Gizzard-plates rudimentary, cartilaginous; 2 uncini on each side; shell with spiral series of oblong rings: *punctata, angulata.*
aaa. Gizzard-plates entirely wanting.
b. Uncini strong, hamate.
c. One uncinus on each side; shell very smooth, oblong *nitida.*
cc. Two uncini on each side; shell spirally chain-striate.
d. Shell ovate: *quadrata.*
dd. Shell oblong: *lima.*
bb. Uncini delicate, exserted, little curved.
c. Six uncini on each side.
d. Shell latticed: *pruinosa.*
dd. Shell striated lengthwise: *flexuosa.*
cc. Two uncini on each side; shell very smooth: *velutinoides.*

P. ARGENTATA Gould. *Unfigured.*

Shell square-ovate, compressed, very thin, lucid, with the luster of talc; concentrically waved and engraved with transverse silvery lines. Apex indented and calloused; lip widely standing out behind, subtruncate in front; columella with a distinct fold. Length 6, diam. 5 mill. Very much like *P. scutulum* Lovén, except in its sculpture. Distinguished from *P. vitrea* by its off-standing lip and silvery grooves. (*Gld.*).

Hakodadi Bay, Japan, 2–6 fms. (Stimp.)

Philine argentata GLD., Proc. Bost. Soc. vii, p. 139; Otia, p. 111.

P. ACUTANGULA A. Adams. *Unfigured.*

Shell rather squarely ovate, white, thin, somewhat truncated behind; transversely sulcate, the sulci excavated-punctate; last whorl

with subparallel sides; aperture open; lip-edge semicircular, with the hind angle incurved, produced and acute. (*Ad.*).

Gulf of Lian-tung; Hulu-Shan Bay (Ad.).

P. acutangula Ad. Ann. Mag. (3), ix, p. 161.

The nearest approach to this species is *P. scutulum* Lovén; but the produced sharp hind angle of the outer lip will serve readily to distinguish it. (*Ad.*).

P. truncatissima Sowerby. Pl. 2, figs. 19, 20.

Shell short, subquadrate, subcompressed, thin, diaphanous, marked with distant concentric opaque lines which are angular in front; aperture very wide in front, widely truncated; outer lip angular. (*Soub.*).

Habitat unknown.

Philine truncatissima Sowb., C. Icon. xviii, pl. 1, f. 5*a*, *b*.

This transparent little species is remarkable for the truncated character of the widened anterior, producing an angle on the lower part of the outer lip; which is beautifully indicated by the opaque white lines delineating the edges of former outer lips. (*Sowb.*).

P. japonica Lischke. Pl. 2, figs. 23, 24 (type); figs. 17, 18 (*striatella* Tap.-Can., enlarged).

Shell square-ovate, thin, milky or bluish-white, generally pellucid below; sculptured with irregular, low growth-wrinkles and close, fine spiral impressed lines, sometimes subobsolete below. Vertex narrow, rather deeply umbilicated, showing one whorl; body-whorl with a shallow, wide spiral depression in the middle and another above it. Aperture extremely large, broad, effuse and subtruncate below, deeply sinused above; outer lip prominent and obtusely angular at the junction of the lightly arcuate outer and basal margins, produced in a widely rounded lobe above the vertex. Columella deeply and equably arched, margined by a slight groove. Alt. 12–13, diam. 10 mill.; alt. 14, diam. 11½ mill.

Bay of Yedo (Lischke); *Yokohama* (Magenta).

P. japonica Lischke, Malak. Blätter, xix, p. 105 (June, 1872); Jap. Meeres-Conchyl. iii, p. 77, pl. 5, f. 13, 14.—*P. striatella* Tap.-Can. Zool. del Viaggio intorno al Globo della R. Fregata Magenta, Malacol., p. 109, pl. 2, f. 9, 9*a* (shell), 9*b* (dentition); 1874.

The squarish form and close, simple striæ are characteristic, though in some specimens the grooves are rather irregular and more spaced, and subobsolete on the base. Often there is an appearance of two or three faint, more hyaline bands on the back. Occasionally the grooves of the outer surface project as slight raised threads inside the shell, as Lischke describes for *P. scalpta* Ad. The dentition according to Tapparone-Canefri, is after the formula 1·0·1, laterals denticulate. The gizzard-plates of specimens collected by Frederick Stearns are well calcified, two of them large, subtriangular, with a slight swelling on the middle of the long side, ends attenuated; the third is shorter, much narrower and fusiform. *P. striatella* T.-C. is undoubtedly synonymous; the type measured 14 x 11½ mill., exactly the dimensions of a specimen collected by Stearns.

P. SCALPTA A. Adams. Pl. 2, figs. 21, 22.

Shell oblong ovate, white, thin, semipellucid; subplicate lengthwise, the folds irregular, engraved by wavy, transverse, distant impressed lines. Aperture ample; columellar margin thin, acute; lip regularly arched, rounded posteriorly. (*Ad.*).

Bay of Yedo (Lischke); *Tsu-Sima* 30 fms.; *Corea Strait*, 46 fms. (Ad.).

P. scalpta AD., Ann. Mag. N. H. (3), ix, p. 160 (Feb., 1862).—LISCHKE, J. M.-C. ii, p. 171; iii, p. 76, pl. 5, f. 15, 16.—*cf. P. sculpta* (*sic*), Tap.-Can., Viag. Magenta, p. 109.

Bulla exarata Ph., or *Haminea sinensis* A. Ad., is the only species resembling this in sculpture; but the form is very different; the body-whorl in that species is large, and the outer lip narrowed posteriorly and greatly produced. (*Ad.*).

Lischke has figured this species from specimens collected in the Bay of Yedo, and gives the following notes: These have much similarity to *P. japonica* in form, especially in the proportion of the convolute portion of the shell to the extremely wide aperture; but the shell is thinner, narrower, equably and less strongly convex than in *P. japonica;* the spire is only superficially sunken, the columella without bordering groove, the outer lip not so much extended above. Especially different is the sculpture, which here consists of coarse, irregular growth-striæ and more deeply cut, less wavy spiral grooves, more widely spaced, with broader smooth girdles between. These grooves are so deep in comparison with the thickness of the shell that they form fine raised lines on the interior of the aperture.

P. CRENATA A. Adams. *Unfigured.*

Shell ovate, white, slightly solid; somewhat angular behind; transversely deeply sulcate, the sulci transversely excavated-punctate, their margins crenate. Aperture dilated; columellar margin obliquely truncated in front; lip semicircular, a little produced behind and rounded. (*Ad.*).

Tsu-Sima 30 fms.; *Korea Strait*, 46 fms. (Ad.).

P. crenata AD., *l. c.* p. 160.

No species has been described resembling this, which is nearly as large as *P. coreanica*. The edges of the transverse grooves are conspicuously crenate, and the puncta or pits are transversely oblong. (*Ad.*).

P. STRIOLATA A. Adams. *Unfigured.*

Shell small, ovate, white, thin, semipellucid, rounded behind; plicate lengthwise, transversely striolate, the striolæ close and very fine; aperture dilated; columellar margin arcuate; lip regularly semicircular, produced and rounded behind. (*Ad.*).

Tsu-Sima, Japan, 30 fms. (Ad.).

P. striolata AD., Ann. Mag. N. H. (3), ix, p. 161.

In form this little species most nearly approaches *Bullæa pruinosa* Clark, from the British Seas; but in sculpture it is entirely different, being very finely transversely striated. (*Ad.*).

P. COREANICA A. Adams. Pl. 2, fig. 15.

Shell subquadrately oval; outer margin rather straight, its upper angle truncated; spire rather elevated. (*Ad.*).

Corean Archipelago, on mud flats (Ad.).

Bulla (*Philine*) *coreanica* A. AD., Thes. ii, p. 601, pl. 125, f. 166 (shell).—*B. coreanica* ADS. & RVE., Zool. Samarang, Moll. p. 65, pl. 18, f. 3 (animal).—*P. coreanica* SOWB. in Conch. Icon. xviii, f. 3.

P. VITREA Gould. *Unfigured.*

Shell of moderate size, fragile, glassy, pellucid and iridescent; roundly ovate, depressed, marked with sinuous concentric waves. Apex opaque, hardly indented, showing one whorl. Aperture very ample; lip rounded above; columella acute, foldless, openly showing the interior of the shell. Length 10, breadth 8, dorso-ventral alt. 3 mill. (*Gld.*).

Hong Kong (Stimp.).

Philine vitrea GLD., Proc. Bost. Soc. N. H., vii, p. 139, (Oct. 1859); Otia Conch., p. 111.

P. ORIENTALIS A. Adams. Pl. 2, fig. 16.

Shell ovate-rounded, subinvolute, white, solid, shining; no spire; aperture large, spreading in front; lip semicircular, the upper angle produced and rounded. (*Ad.*).

This species has somewhat the form of *P. aperta*, but wants the transverse impressed groove seen in that species; the plates of the gizzard, moreover, are produced at each end into long, slender processes, somewhat similar to those of *P. schræteri*, the shell of which is very different in form. (*Ad.*).

Lat. 6° 54′ *N.*, *long.* 122° 18′ *E. Off Malanipa, Basilan Strait, Philippines*, 10–20. fms. (Challenger).

P. orientalis A. AD., P. Z. S., 1854, p. 672.—SOWB. in Conch. Icon., xviii, pl. 2, f. 11.—WATSON, Chall. Gastr., p. 672.

P. ANGASI Crosse & Fischer. Pl. 3, figs. 59 (type), 57, 58.

Shell oblong, longitudinally very delicately wrinkle-striate, thin, pellucid, shining, hyaline-milky; apex rounded, a little concave in the middle; convex outside, subcylindrical, spirally convoluted within. Aperture very ample at base, the outer margin semicircular, simple, acute, extending some above the apex. Interior covered with a white, pellucid, very thin callus in adults. Alt. 30, diam. 20 mill. Stomach plates very solid, looking like a cocked hat. (C. & F.).

St. Vincent's Gulf and Port Jackson (Angas); *Torres Strait* (Brazier); *New Zealand* (Hutton).

Bullæa angasi C. & F., Journ. de Conch., 1865, p. 38, pl. 2, f. 8. —*Philine angasi* ANGAS, P. Z. S., 1865, p. 189; 1867, p. 227.—BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 88.—SOWB. in Conch. Icon., xviii, pl. 1, f. 4.—WATSON, Chall. Gastrop., p. 671.—HUTTON, Journ. de Conch., 1878, p. 41.

This species has repeatedly been declared identical with *P. aperta*, but it seems to have the lip less angular above than usual in that species, and the stomach-plates are probably different, judging from the brief remark of C. & F. to the effect that they are very solid "et affectent l'apparence d'un chapeau à cornes." One would hardly say this of the plates of *P. aperta* (pl. 9, f. 1, 2, 3, 6, 7). At

all events the matter merits further investigation before the conservative malacologist can be satisfied to declare the Austral and North Atlantic forms identical; and in this connection the alleged occurrence of *P. aperta* or *schroeteri* in the Philippines needs confirmation. Watson (*l. c.*) retains *angasi* and *aperta* distinct.

P. CAURINA Benson. *Unfigured.*

Shell ovate-oblong, white, very thin, papery, transversely elegantly and most minutely striatulate; aperture auriform, narrowed above, patulous below; lip rising above the vertex; spire none. (*Bens.*).

Tinghae, Chusan (Dr. Cantor).

Bullæa caurina BENS., Journ. Asiat. Soc. Beng. xxiv, 1855, p. 128.

The part of the body-whorl which is visible when the aperture is turned towards the observer, is small in proportion to the mouth. The summit of the shell resembles the same part in *Bulla navium* and *B. solida*, but the outer lip is destitute of the fold where it rises above the apex, which appears in those species; resembling in this respect *B. ampulla*. The thinness of the inner lip locates this shell in *Bullæa*. Its being internal, probably accounts for the state of Dr. Cantor's specimens from the contraction of the cooked animals, compressing the very fragile shells. The same circumstance may have occasioned the want of success met with in the search for living examples. (*Bens.*).

P. ERYTHRÆA H. Adams. Pl. 3, fig. 60.

Shell subquadrate-oval, thin, semipellucid, sculptured with distant transverse lines; aperture ample, dilated in front, the columellar margin thin; lip rounded behind, margin arcuate. Alt. 8, diam. 6 mill. The gizzard of this species has the *plates deeply serrated* on the edges (*H. Ad.*, P. Z. S., 1872, p. 11, pl. 3, f. 11, [shell] 11*a* [gizzard plate]).

Red Sea (McAndrew).

This is "*P. erythræensis=aperta*" of Cooke (Ann. Mag. N. H. [5], xvii, p. 133). It has been stated to be indistinguishable from *P. aperta*, but there seems to be a strong differential feature in the serrated gizzard plates, those of *aperta* being smooth at the edges. I do not know whether *P. vaillanti* is identical with this or not, but in

the absence of information leave it independent for the present. It is a larger shell than this.

P. VAILLANTI Issel. *Unfigured.*

Shell oblong, longitudinally unequally wrinkle-striated, thin, fragile, a little shining, milky-transparent, translucid, with clear bands; convex outside, ovate; inside spirally convoluted; apex excavated or perforate; whorls 1–1½; aperture large, the outer margin strongly arcuate, simple, acute, projecting a little above the apex; inner margin having a very thin whitish callus. Alt. 27, diam. 20 mill.; alt. 24, diam. 19 mill. (*Issel*).

Suez, etc., (Issel).

P. vaillanti Issel, Mal. Mar Rosso, p. 166, (1869).=*B. angasi* Vaillant, J. de C., 1865, p. 110, not of C. & F.

Compare *P. aperta* and *P. erythræa.*

P. APERTA Linné. Pl. 3, figs. 47 to 56. Pl. 9, figs. 1, 2, 3 gizzard plate; 4, 5 radula; 6 mouth, radula-sack and stomach seen from above; 7 seen from the side.

Shell squarish-oval, depressed in front, very thin and fragile, semitransparent, glossy and iridescent; sculpture, plait-like and irregular lines of growth and a few extremely slight and more irregular spiral lines, which latter are not discernible except with a lens and at certain angles of light; the texture examined under a microscope resembles curdled milk; color whitish, with sometimes two or three clear streaks across the back; spire very loosely coiled, with the nucleus extremely small and concealed by a shelly deposit from the hinder lobe of the mantle; it is always more or less indented, and in the young is slightly umbilicate; mouth roundish-oval, of enormous size compared with that of the convoluted portion and occupying seven-eighths of the under surface; it is obliquely truncated above and rounded below; outer lip dilated, with a sinuous and very thin edge; the upper part slopes outwards and projects considerably beyond the spire; inner corner receding and acute-angled; inner lip spread over the pillar, and forming at the angle where it meets the outer lip, a thick and shapeless callus; pillar sharp and flexuous; there is no umbilical groove or depression. (*Jeffr.*).

Alt. 21, diam. 17 mill.

Norway to the Canaries and Cape Verde Is.; Mediterranean; low water to 50 fms: *Cape of Good Hope;* (Chemnitz, Krauss); *Querimba Is. and Inhambane, E. Africa;* (Peters).

Bulla aperta L., Syst, xii, p. 1183.—*Bullæa aperta* LAM., Anim. s. Vert. vi, p. 30.—*Philine aperta* FORBES & HANLEY, Hist. Brit. Moll., iii, p. 539, pl. 114*e*, f. 1; pl. uu, f. 1.—JEFFREYS, Brit. Conch., iv, p. 457, v, pl. 96, f. 8.—HIDALGO, Mol. Mar. Esp., pl. 21, f. 6, 7.—MEYER & MOBIUS, Fauna Kieler Bucht, p. 77, f. 1–6.—BUQ., DAUTZ. & DOLLF., Moll. Rouss., i, p. 540; pl. 63, f. 10–15.—VAYSSIERE, Rech. Moll. Opisto., p. 33, pl. 1, f. 18–21.—SARS, Moll. Reg. Arct. Norv., pl. xi, f. 15, (anatomy), and of authors generally. See Arch. Zool. Expér., iv, 483, for account of double monsters.—*Phylina quadripartita* ASCANIUS, K. Vetensk. Ak. Stock. Handl., 1772, p. 329, pl. 10, f. A, B.—CHENU, Manuel de Conch., i, p. 392, f. 2972.—A. AD., Thes. Conch., p. 599, pl. 125, f. 159.—*Lobaria quadriloba* MULLER, Zool. Dan., iii, p. 30, pl. C, f. 1–5.—*Lobaria quadrilobata* GMEL., Syst. xiii, p. 3143.—*Bullæa planciana* LAM., Syst. An. s. Vert., p. 63.—PHIL., Enum. Moll. Sicil., ii, p. 94, pl. 20, f. 3.—*Bullæa schroeteri* PHIL., *l. c.* p. 94, pl. 20, f. 2.—KRAUSS, Südaf. Moll., p. 70.—*Philine schroeteri* A. AD., Thes., p. 600, pl. 125, f. 160.—BRAZIER, Proc. Linn. Soc. N. S. Wales, ii, p. 88.—*Bullæa capensis* PFR., Krit. Register zu Mart. & Chemn., p. 93.—*Philine capensis* MARTENS, Monatsber. K. P. Akad. Wissensch. zu Berlin, 1879, p. 738.—*Amygdala marina* PLANCUS, De Conchis minus notis, pp. 21, 103, pl. 11, f. d–g.—*Bulla candida* MULLER, (*teste* Jeffreys).—*Bulla bulla* DACOSTA, Hist. Nat. Test. Brit. p. 30, pl. 2, f. 3, (1778).—*Bulla emarginata* J. ADAMS, Trans. Linn. Soc., v, 1800, p. 2, pl. 1, f. 9–11.

P. aperta L., typical, may be retained for the shells from Cape of Good Hope (type locality) and European Seas, with the synonymy given above. *B. schroeteri* Phil. (fig. 50) and *B. capensis* Pfr. are synonyms of the Cape form, the other names belong to the European form, which, if it should prove distinct, will be called *P. quadripartita* Asc. *P. planciana* Phil. (pl. 3, f. 47, 48, typical figures, and fig. 49) is a synonym of this.

Var. *patula* Jeffreys. Smaller, with the mouth larger and more expanded. *Tenby, Dublin Bay, Connemara.* (Brit. Conch., iv, p. 458).

With this species have been united by many late writers, forms of *Philine* from the Red Sea, Australia, etc., which so far as the shells are concerned seem to be almost, if not quite inseparable. It remains to be seen whether the dentition and gizzard-plates will offer features differentiating the Atlantic and Mediterranean form from those of the Indo-Pacific. The descriptions of these forms have been given above, but the question of their status is of course, an open one.

P. SCABRA Müller. Pl. 5, figs. 1, 2, 3.

Shell resembling in shape a miniature Scaphander lignarius, but more cylindrical; it is of a delicate texture, semitransparent, and of a glistening and iridescent lustre; sculpture, numerous and close-set spiral and parallel rows of minute oval dots which are interwoven and arranged like the links of a chain; some of these rows being intermediate, and apparently squeezed or compressed, at the sides become merely fine lines; the front edge or base of the mouth and top of the outer lip are exquisitely fringed with sharpish points, like short teeth of a comb; color clear white when the shell is extracted from the animal, afterwards becoming milk-white; spire slightly prominent; whorls 3; the body whorl (as usual in this genus) is disproportionately large and voluminous; the other two are small with an indistinct and thickened nucleus; suture deep and channelled; mouth acute-angled above, and greatly expanded below, with a squarish base; outer lip gently curved, folding inwards on the upper part; the top of this lip is below the spire; inner corner cloven or excavated, so as to cause a disjunction of the suture in front and a partial separation of the body-whorl from the next; inner lip forming a rather thick and broad glaze. (*Jeffr.*).

Alt. 5–8 mill.

Iceland, Greenland and Norway south to the Bay of Biscay; Mediterranean Sea at Sicily, etc.; Whydah, W. Africa.

Bulla scabra MULL., Zool. Danica, ii, p. 41, pl. 71, f. 10–12.—*Philine scabra* FORBES & HANLEY, Hist. Brit. Moll., iii, p. 543, pl. 114E, f. 4, 5; pl. VV, f. 1.—JEFFREYS, Brit. Conch., iv, p. 447; v, pl. 96, f. 1.—SARS, Moll. Reg. Arct. Norv. p. 294, pl. 18, f. 13a–c.—*Scaphander scabra* SOWB. in Conch. Icon., f. 6.—*S. scaber* SMITH, P. Z. S., 1871, p. 738.—*B. pectinata* DILLWYN, Descr. Cat. Rec. Shells, p. 481.—"*B. pectinata* MULL." of some authors, not of Müller!—*B. denticulata* J. ADAMS, Trans. Linn. Soc., v, 1800, p. 1, pl. 1, f. 3,

4, 5.—*Scaphander catenatus* Leach, Synops. Moll. G. B., p. 40.—*Bullæa catena* and *B. catenulifera* Macgillivray, Hist. Moll. Anim. Aberdeen, Kincardine and Banff, p. 68, (1843).—*Bullæa dilatata* Searles Wood, *olim*, see Crag Moll., i, p. 181, pl. 21, f. 12*a–c*.—? *Bulla angustata* Bivona, Phil., Enum., i, p. 121, pl. 7, f. 17c.—? *B. punctata* Phil., *l. c.* ii, p. 95. (See under next species).—*Scaphander patulus* Risso, Hist. Nat. Eur. Mérid., iv, p. 51.—*Bullæa granulosa* M. Sars, Beskriv. og Iagttagelser, p. 75, pl. 14, f. 3*b*, (1835).

Some of the earlier names quoted above are more or less doubtful. It is allied to *P. catena*, but readily distinguishable.

P. catena Montagu. Pl. 5, figs. 23, 24, 25.

Shell oval, compressed and expanding outwards, of delicate but not fragile texture, semitransparent and glossy; sculpture, numerous and close-set spiral rows of minute links, arranged in a chain-like fashion, which vary in shape from roundish-oval to oblong, besides occasional intermediate lines as in *P. scabra;* the edge of the mouth (especially at its base and on the upper part of the outer lip) is finely scalloped by the continuation of the spiral sculpture; color as in the last species; spire extremely small, but prominent; whorls 2–3, similar (except in size) to those in the last species; suture narrow, deep and channelled; mouth equalling about three-fourths of the circumference of the shell, broadly oval, contracted above by the periphery, with a bluntly rounded (or almost truncated) base; outer lip flexuous, slightly indented or concave in the middle; the top is level with the spire, the shell being placed mouth downwards; inner corner cloven and producing the same partial disconnection of the body-whorl as in the last species; inner lip forming a broad and thickened glaze. (*Jeffr.*).

Alt. 2½ to 4 mill.; the larger forms from northward.

Lofoten, Norway and British Seas south to Gulf of Gascony and Canary Is.; Mediterranean and Adriatic Seas; laminarian zone. Coralline Crag; Post-pliocene of Calabria.

Bulla catena Mont., Test. Brit., p. 215, pl. 7, f. 7.—*Philine catena* Forbes & Hanley, Hist. Brit. Moll., ii, p. 545, pl. 114e, f. 6, 7; pl. uu, f. 4.—Jeffreys Brit. Conch., iv, p. 449; v, p. 224, pl. 96, f. 2.—Sars, Moll. Reg. Arct. Norv., p. 294, pl. 26, f. 6a–c.—Buq., Dautz. & Dollf., Moll. Rouss., i, p. 543, pl. 64, f. 21, 22.—*Bullæa catina* Brown, Illustr. Conch. G. B., p. 57, pl. 19, f. 33, 34.—*Bul-*

læa angustata Bivona, Phil., Enum. Moll. Sicil., i, p. 121, pl. vii, f. 17 *a, b, d.*—*Bullæa punctata* Phil., *l. c.* ii, p. 95 (not of Clarke).—*Bullæa catenata* Thorpe, Brit. Mar. Conch., p. 138, pl. 7, f. 81, and of Réquien and Petit.—? *Bulla punctata* J. Adams, Trans. Linn. Soc., v, p. 2, pl. 1, f. 6–8, 1800.—? *Bullæa punctata* Moller, Ind. Moll.—*Bullæa sculpta* Searles Wood, Crag Moll., i, p. 180, pl. 21, f. 10*a–c.*

Var. *zona* Jeffreys. Rather more depressed, with a belt of clear white in the middle, taking in from eight to ten of the chain-like rows. Bigberry Bay near Plymouth, and Guernsey.

P. loveni Malm. Pl. 4, figs. 83, 84, 85.

Shell thin, semipellucid, oblong, rather narrow, wider below, tapering toward the apex, the vertex narrowly truncate, hardly oblique; spire distinct; whorls 3. Aperture expanded and obtusely rounded below, much contracted above. Sculpture as in *P. scabra;* lip edge smooth throughout, not dentate or serrate. Alt. 7 mill. Radula as in *P. scabra.*

Norway.

Philine loveni Malm, Sars, Moll. Reg. Arct. Norv., p. 295, pl. 26, f. 5*a–d.*

P. finmarchica M. Sars. Pl. 5, figs. 14, 15, 16.

Shell thin and fragile, pellucid, of an oblong-ovate form, dilated in the middle, the vertex obliquely truncate; spire minute, impressed; whorls 2; aperture ample, equably rounded at base and rather expanded, contracted behind, the outer lip slightly concave in the middle; above forming a narrow lobe scarcely produced above the vertex; columella equally concave. Surface sculptured with extremely close simple undulating spiral striæ, and less close oblique growth-striæ; edge of lip smooth. Alt. 7 mill. Lateral teeth rather large, with a finely serrulate crest inside; no uncini; formula 1·0·1. (*Sars*).

Finmark.

P. finmarchica Sars, Moll. Reg. Arct. p. 296, pl. 18, f. 10*a–d.*

P. ossiansarsi Friele. Frontispiece, figs. 19, 20, 21, 22.

Form oval, the number of whorls 2½–3 are visible on the spire which is depressed and in line with the body-whorl; apex small and

not raised; suture shallow round the top whorl, but deepens toward the aperture, and terminates in a rather short and narrow slit; ventral whorl is of a size equal to about half the aperture; columella much curved, mouth large, piriform, expanded and rounded below, contracted above but not pointed; lip very little sinuous, and somewhat concave on the upper part; the inner lip forming a very thin callus on the pillar. Shell thin and white; sculpture consists of numerous lines of growth and microscopical close-set transverse lines. Alt. 9, diam. 6·5 mill.

Cold area, N. Atlantic, Norweg. N. Atl. Exp. 1876, station 18, 400 fms. and station 87, 488 fms.

Philine Ossian-Sarsi Friele, Nyt Magazin for Naturvidenskaberne, 1877, xxiii, 3, p. 9, f. 19 (shell), 19*a*, *b* (radula), 19*c*. (gizzard plate); Jahrb. D. M. G. iv, 1877, p. 264.—*P. ossiani* Kobelt, *l. c.* footnote.

Seems to be a more attenuated species than *finmarchica* or *fragilis*, the species most nearly allied.

Fig. 22. The teeth (radula) has 16 joints. Gizzard is armed with three uncommonly large and stout plates, fig. 21, measuring no less than 6 mm. The living animal being 15 mm. long the gizzard consequently measures two-fifths of its length and two-thirds of the shell. (*Friele*).

P. fragilis Sars. Pl. 5, figs. 20, 21, 22.

Shell very thin and fragile, pellucid, slightly opaline: ovate, rather ventricose, the base widely rounded, vertex truncated by nearly a straight line; spire distinctly impressed; whorls 3; aperture very ample; outer lip flexuose, somewhat projecting toward the vertex, the terminal lobe rather wide, truncated; columella profoundly concave; umbilical impression distinct, linear. Surface sculptured with numerous growth-striæ decussated by dense, undulating spiral lines. Alt. 11 mill. Lateral teeth having a smooth, not serrate, keel within; no uncini; formula 1·0·1.

Vadso, Norway in deep water.

P. fragilis Sars, Moll. Reg. Arct. Norv. p. 296, pl. 18, f. 11a–c.

P. cingulata Sars. Pl. 5, figs. 4, 5, 6.

Shell minute, but less fragile than ordinary, subopaque, quadrangular-ovate, nearly as wide as long, dilated in the middle; vertex

obliquely truncate, the spire impressed, whorls 2. Aperture patulous, roundly truncate at base, the outer lip nearly straight in the middle, the posterior lobe projecting a little above the vertex; columella equally emarginate. Surface conspicuously spirally striolate, striæ thick, opaque, formed of a series of many confluent impressions; lip edge slightly crenulated. Alt. 2 mill. Lateral teeth of radula having a distinctly serrate crest inside; no uncini; formula 1·0·1. (*Sars*).

Lofoten, Norway, 120–200 fms.

Philine cingulata Sars, Moll. Reg. Arct. Norv. p. 297, pl. 26, f. 7a–c.

The comparative solidity, strong sculpture and total lack of uncini are characteristic.

P. infortunata Pilsbry, n. n. Pl. 5, figs. 12, 13.

Shell very thin and pellucid, glassy, rotundly-ovate, slightly longer than wide, the base equably rounded; vertex obliquely truncate, narrow; spire distinct, impressed. Whorls 2. Aperture very large and spreading, the onter lip obliquely expanded, continued above the vertex and forming nearly a right angle there. Columella deeply concave. Surface very smooth, rather shining, lacking spiral striæ, the growth-striæ arcuate and very delicate. Alt. 3 mill.

Lofoten, Norway,

Philine vitrea G. O. Sars, Moll. Reg. Arct. Norv., p. 298, pl. 26, f. 8*a*, *b*. Not *P. vitrea* Gould, 1859.

Utriculopsis vitrea M. Sars, Nyt Mag. f. Naturvidens., 1870, xvii, p. 177, pl. 11, f. 15–18 (animal only, exclusive of shell, which=*Diaphana globosa*, *cf.* Manual vol. xv, p. 286); Bidr. til Kundskab Christianiafjordens Fauna, ii, p. 65, pl. 11, f. 15 (not f. 16–18,=*Diaphana globosa* Lovén). Compare Brogger, Bidr. Krist. Moll. Fauna, p. 40; Zool. Rec. ix, p. 141.

The globose form, angularly produced upper lobe of the lip, and lack of spiral striæ, are characteristic. The synonymy is not wholly satisfactory, but as I have not the means of settling it, I have been content to follow Sars' view, which is that the elder Sars figured under the name *vitrea* the *animal* of this species and the *shell* of *Diaphana globosa*. His figures of the latter are copied for comparison on pl. 3, f. 44, 45, 46. See preceding volume, p. 286.

P. PUNCTATA Clark. Pl. 4, fig. 69; pl. 9, fig. 9 (*Colpodaspis*).

Shell oval, convex, but somewhat compressed in the middle, of delicate texture, nearly transparent, and glossy; sculpture, extremely numerous and close set spiral rows of minute rings or impressed circular dots, which are not united or chain-like, but appear punctate; edge of the mouth plain at its base and slightly scalloped at the top of the outer lip; color as in all the foregoing species; spire very small, but prominent; whorls 2, similar to those of the other species; suture narrow, deep, and channelled; mouth regularly oval, rounded at the base; outer lip flexuous, widely indented or slightly concave in the middle; the top lies somewhat below the spire; outer corner bluntly angulated, and projecting; inner corner cloven and causing a disconnection of the outer whorl from the next; inner lip narrow, folding over the pillar, behind which is a depression or approach to an umbilicus. (*Jeffr.*).

Alt. 2½, diam. 1·9 mill.

British Seas (Jeffr.); *Florö̈en, etc., Norway* (Sars); *Algiers*, 35 fms. (McAndrew); *Suda Bay, Candia, Aegean Sea*, 119 fms. (Forbes); *Cape S. Vito and Palermo* (Monts.).

Bullæa punctata CLARK, Zool. Journ. iii, 339.—*Philine punctata* FORBES & HANLEY, Hist. Br. Moll. iii, p. 547, pl. 114E, f. 8, 9; pl. UU, f. 5.—JEFFREYS, Brit. Conch. iv, p. 455; v, pl. 96, f. 5.—AD. in Thes. Conch. p. 600, pl. 125, f. 161.—SOWB., C. Icon. f. 9.—*Bullæa alata* FORBES Rep. Ægean Invert., Rep. Brit. Asso. Adv. Sci. 1843, p. 187.—*Colpodaspis pusilla* M. SARS, Bidrag til Kundskab om Christianiafjordens Fauna, ii, p. 70–74, pl. 11, f. 1–6.—G. O. SARS, Moll. Reg. Arct. Norv. pl. xii, f. 15 (dentition).

P. ANGULATA Jeffreys. Pl. 3, figs. 41, 42.

Shell rhomboidal, depressed, fragile, transparent and glossy; sculpture, numerous rows of very fine spiral striæ, composed of oval and almost microscopic dots, and appearing punctate; the upper part of the body-whorl is angulated or margined by a sharpish keel, between which and the suture is a flattened space marked with 5 of the spiral striæ and sloping towards the spire; there is also a tendency to angularity in other parts; edge of the mouth plain or smooth; color clear white, becoming opaque in dead specimens which have been picked out of shell-sand; occasionally one or two transparent zones may be seen, as in the variety of *P. catena*; spire extremely small, slightly prominent; whorls 2–3, conspicuous; the

outer edge of each is keeled or ridged ; suture deep and channelled ; mouth squarish, remarkably wide and large, nearly truncated at the base ; outer lip forming an obtuse angle at the junction of the front and base ; the top is higher than the spire, and it projects outwards; inner corner deeply and widely cloven, so as to make the disjunction of the outer whorl from the next very conspicuous ; inner lip forming a narrow but thick ledge or fold, behind which is a slight depression. (*Jeffr.*). Alt. 2·5, diam. 1·9 mill.

Larne Co., Antrim, Hebrides and Shetland, 60–80 fms. ; *Aberdeenshire.*

Philine angulata Jeffr., Brit. Conch. iv, p. 451 ; v, pl. 96, f. 3. —Sowb. in C. Icon. f. 12.

The keeled spire will serve to distinguish this from any other species of *Philine* having conspicuous spire and chain-like sculpture.

P. nitida Jeffreys. Pl. 4, figs. 81, 82 ; figs. 79, 80.

Shell oblong, convex, very thin and fragile, nearly transparent, and of a polished luster ; sculpture, none on the body-whorl ; but the spire has two keels or ridges, one at the outer edge of each whorl, and the other in the middle, giving this part an angulated appearance, color clear-white, becoming opaque in dead specimens ; spire flattened, placed somewhat obliquely ; it is quite exposed and occupies the top of the shell ; whorls 2½, irregularly twisted, but distinct ; suture deep and excavated ; mouth oval, truncated above, wide and rounded below, its area equals about two-thirds of the under surface ; outer lip expanded, squarish at the top, and gently curved in the middle ; it is level with the spire, viewed mouth downward, and is below it, viewed mouth upwards ; outer corner angular and projecting ; inner corner considerably receding and acute-angled ; inner lip forming a broad glaze on the upper part, and reflected on the pillar ; there is no umbilical groove or depression. (*Jeffr.*).

Alt. 1·8 mill.

Skye ; Haroldswick Bay, Unst ; Ulfsfjord and Tromso, Norway.

Philine nitida Jeffr., Brit. Conch. iv, p. 456 ; v, pl. 96, fig. 7.— *Philine sinuata* Stimps., Sars, Moll. Reg. Arct. Norv. p. 298, pl. 26, f. 9*a–c.*

Jeffreys' figures would hardly justify the union of his species with that of Sars, but the description leaves little doubt of their identity.

Compare *P. sinuata* Stimp. The keeled vertex, exposed spire and lack of spiral striation are its more prominent features.

P. SINUATA Stimpson. Frontispiece, fig. 23.

Shell minute, ovate, white, pellucid, longitudinally striated; spire conspicuous; aperture dilated in front. Alt. 1·75, diam. 1·25 mill. (*Stimps.*).

Broad Bay, Boston Harbor, 4–7 fms., sand.

Philine sinuata STIMP., Proc. Bost. Soc. N. H. iii, p. 333 (1850); Shells of New England p. 51, pl. 1, f. 7.—GOULD–BINNEY, Invert. Mass. p. 213, fig. 502.

Evidently allied to *P. nitida* Jeffreys, but the crown is not acutely keeled as in that form, and is narrower.

P. QUADRATA S. Wood. Pl. 5, figs. 17, 18 19; pl. 3, fig. 43.

Shell squarish-oval, convex, contracted or compressed on the upper part below the spire, and bluntly angulated in the middle; it is not very thin, is semitransparent, and when fresh of a glistening luster; sculpture, numerous rows of fine spiral striæ, which are composed of minute oval dots and appear punctate; these striæ are irregularly disposed, being in some parts more close together than in others, and they here and there form intermediate and slight lines; the upper part of the body-whorl is thickened and rounded, and the middle is furnished with a blunt and slight spiral rib, which is usually visible also within the mouth; the top of the outer lip is delicately scalloped; color white, crystalline when extracted from the animal; spire small, more or less sunken; apex obscure; whorls 2–3 rounded; the inner ones are minute; suture deep; mouth broadly oval, contracted above by the periphery, and expanded below, with the base obliquely curved and somewhat truncated; it occupies about two-thirds of the underside of the shell; outer lip nearly straight in front and forming an obtuse angle at the junction of that part with the base; the top is rather higher than the spire, and projects outwards; outer corner bluntly angular or rounded; inner corner receding and acute-angled, but not exhibiting any further disjunction of the outer whorl from the next; inner lip broad and thick. (*Jeffr.*). Alt. 7–8 mill.

Northern British Seas; Scandinavia; Greenland; off New England; Bay of Biscay (Jeffr.); *off Fayal*, 50–90 fms., *and St. Miguel, Azores*, 100 fms. (Chall.); *St. Helena*, 50–80 fms. (Capt. Turton).

Bullæa quadrata Wood, Ann. N. H. (n. ser.) iii, p. 461, pl. 7, f. 1; Crag Moll. i, p. 179, pl. 21, fig. 9.—*Philine quadrata* Forbes & Hanley, Hist. Brit. Moll. iii, p. 541, pl, 114E, f. 2, 3.—Jeffreys, Brit. Conch. iv, p. 452; v, p. 224, pl. 94, fig. 4; Ann. Mag. N. H. (5), vi, p. 318.—Smith, P. Z. S., 1890, p. 297.—*P. qvadrata* var. *grandis* Leche Kongl. Sw. Vet. Akad. Handl. xvi, p. 75, 1878.—Sars, Moll. Reg. Arct. Norv. p. 299, pl. 18, f. 9; pl. xii, f. 7.—Sowb., C. Icon., f. 13.—Gould-Binney, Invert. Mass. p. 213, f. 503.—Watson, Chall. Gastr. p. 672.—*P. scutulum* Loven, Ind. Moll. Scand., Ofvers. Kongl. Vet-Akad. Förhandl. 1846, p. 9; Ad. in Thes. Conch., p. 601, pl. 125, f. 164.—Sowb. in Conch. Icon. f. 6.—*P. formosa* Stimp., Proc. Bost. Soc. N. H. iii, p. 334; Shells of New England, p. 51.

Leche indicates a var. *grandis*, alt. 10, diam. 7½ mill., from the Kara Sea.

P. monterosatoi Jeffreys. Pl. 4, fig. 65.

This shell resembles *P. quadrata*, but is more transparent, ordinarily larger, and has a system of sculpture of great beauty. It is also distinguished by the aperture which is rounder, and by a visible groove extending from summit to the median part of the shell. (*Monts.*).

'*Adventure*' *Bank, Mediterranean*, 92 fms. (Jeffr.); *Palermo and St. Vito* (Monts.); *Marseilles* (Marion); *Gulf of Gascony* (Hirondelle).

P. monterosatoi Jeffr. *MS.*, Monts., Not. Conch. Medit. p. 55; Journ. de Conch. 1874, p. 281.—Dautzenberg, Mém. Zool. Soc. France iv, 1891, p. 613, pl. 16, f. 3.

P. lima Brown. Pl. 5, figs. 7, 8, 9, 10, 11.

Shell not fragile, rather solid, narrowly oblong, the base wider and obtusely rounded, the vertex narrow; spire distinct, more or less raised, sometimes almost mamillate. Whorls 3–4, separated by a narrow suture; aperture narrowed above and remote from spire, below a little dilated; outer lip slightly sinuous, appressed above, hardly lobed; columella a little concave. Surface sculptured with spiral pairs of scalloped lines forming a chain, alternating with other more appressed lines; edge of the lip smooth. Alt. 7 mill. or less. (*Sars*).

Ulfsfjord, north of Tromso, Norway; Cape Cod to Grand Manan; Palermo; (Monts.).

Utriculus lima BROWN, Ill. Conch. G. Brit., p. 58, pl. 19, f. 39, 40.—*Philine lima* SARS, Moll. Reg. Arct. Norv., p. 300, pl. 18, f. 12*a–f*.—*Bulla lineolata* COUTH., Bost. Journ. N. H., ii, p. 179, pl. 3, f. 15, (1839); Amer. Jour. Sci., xxxvi, p. 389, (1839).—GLD., Invert Mass., i, p. 169, f. 99.—DEKAY, N. Y. Moll., p. 16, pl. 35, f. 334.—*Philine lineolata* STIMP., New Engl. Shells, p. 51.—GLD.-BINN., Invert. Mass., p. 214, f. 504.—LECHE, Kongl. Sv. Vet. Akad. Handl. 1878, p. 76.

P. FLEXUOSA M. Sars. Pl. 4, figs. 86, 87, 88, 89.

Shell ovate, white, pellucid, thin, much contracted and slightly sinuate above; growth striæ very dense, spiral striæ obsolete and distant. Spire minute; whorls 6, impressed, slightly umbilicate. Aperture widest in the middle, produced and rounded below, narrowed above; outer lip arcuate, slightly pressed inward and sinuous above, then produced, projecting a little way above the vertex, separated by a narrow sinus from the columellar margin. Columella sinuate-arched, rimate, covered with a thin callus. Alt. 10, diam. 7 mill.

Aasgaardstrad, w. side Gulf of Christiania (Sars); *Yucatan Strait*, 640 fms. (Blake).

Philine flexuosa M. SARS, Nyt. Mag. f. naturvidens. xvii, p. 181, pl. 11, f. 23–26; Bidrag til Kundskab om Christianiafjordens Fauna, pp. 69, 70, pl. 11, f. 23–26; Christ. vid. Selsk. Forh., 1858, p. 85.—G. O. SARS, Moll. Reg. Arct. Norv. p. 303, pl. xii, f. 13 (dentition).—DALL, Bull. M. C. Z., xviii, p. 59.

P. VELUTINOIDES G. O. Sars. Pl. 5, figs. 26, 27, 28.

Shell very thin and fragile, extremely pellucid, hyaline, of a peculiar ovate-triangular form, the length and breadth nearly equal, narrowed and rounded towards the base, wider and truncated at vertex; spire distinct, obliquely impressed; whorls 2½, the first half-globular, suture deep. Aperture spreading, the outer lip much expanded and arched, upwardly projecting above the vertex in an obtuse, rounded lobe; columella slightly concave, bearing a thin, reflexed callus, spreading over part of the ventral surface and partly covering the narrow umbilicus. Surface very smooth, shining, without spiral striæ, but with very delicate, arcuate growth-lines. Alt. 2·7 mill. (*Sars*).

Lofoten, Norway.

Philine velutinoides Sars, Moll. Reg. Arct. Norv., 1878, p. 302, pl. 26, f. 10*a–c*.

The wideness of the upper part is peculiar and unusual, and lends much probability to the view that *Utriculus ventrosus* Jeffr. (*Diaphana ventricosa* Jeffr., Vol. XV, p. 284) may be the same. In that case, *velutinoides* will become a synonym of Jeffreys' species.

P. polaris Aurivillius. Pl. 3, figs. 39, 40.

Shell very thin, fragile, pellucid, oblong-ovate; whorls 3–4. Aperture ample, expanded at base, contracted above, the outer lip more appressed than in *P finmarchica*. Surface covered with spiral, very delicate pairs of lines, scalloped chain-wise. Alt. 3, diam. 2·5–2 mill. Radula with the formula 2·1·0·1·2, laterals and uncini edentulous, of equal length. (*Auriv.*).

N. of Siberia, lat. 73° 5′, *E. long.* 144° 20′, *and* 73° 28′, 164° 10′, 8–9 fms.

P. polaris Auriv., Vega-Exped. Vetenskapliga Iaklagelser, iv, pp. 371, 380, pl. 12, f. 21, 22 (shell); pl. 13, f. 18 (radula).

Shell has most similarity to *P. finmarchica*. but the radula is more like that of *P. quadrata* except that the laterals apparently have no serrate crest. A more proper grouping of the species geographically would bring it among the N. Pacific forms, but faunally the Arctic Sea is allied more to the N. Atlantic.

P. membranacea Monterosato.

I do not know that a description or figure of this form has been published. The diagnoses of Mediterranean forms of Tectibranchs and Polyplacophora in Carus' Prodromus Faunæ Medit. are such a maze of blunders that the work is not worth quotation; but this form is not mentioned therein.

Coast of Algeria 207 fms. (Jeffr.); *Gulf of Naples* (Acton); *Palermo* 60–90 meters (Monts.).

P flexuosa Sars, Monts., Nuova Rivista, p. 48; Enum. e Sinon., p. 52. Not *P. flexuosa* M. Sars.—*P. membranacea* Monts., Bull. Soc. Mal. Ital., vi, p. 78.

P. striatula Jeffreys.

Resembles *P. punctata* Clark in size, but differs in the spire, system of sculpture and the more dilated aperture. (*Monts.*).

Ann. Mag. N. H. (5), vi, p. 318; Rep. Br. Asso., 1873, p. 114, as *Utriculus striatulus*. See Nuova Rivista, p. 48, and Journ de Conch. 1874, p. 281.

Still undescribed, unless the preceding note by Monterosato be called a description; and originally mentioned as a *Utriculus* by inadvertence. Reported thus far from off coast of Algeria 207 fms. (Jeffr.), Palermo and St. Vito, 90–200 meters (Monts.), and Bay of Biscay (Jeffr.).

P. VITREA Monterosato. Undescribed; unfigured.

Palermo, 90 meters.

Nuova Rivista, p. 48. A nude and preoccupied name.

P. INFUNDIBULUM Dall. *Unfigured.*

In the multiplicity of species of *Philine* this one is best described by a comparative diagnosis. The soft parts externally are whitish, and resemble *P. quadrata* and *P. finmarchica* as figured by G. O. Sars. It is nearest *P. quadrata* so far as shell characters go, and belongs to the group of species which have the spire entirely immersed and the posterior junction of the outer lip descending upon it in a sort of spiral. The shell is thin, pellucid, and finely closely spirally striate. It differs from that of *P. quadrata* chiefly by its larger size and the much smaller proportion wrapped in the body-whorl. The soft parts though larger, are remarkably like those of *P. quadrata*, but in that species the ventricular plates are wanting. In the present species they are present and of large size, the large (right) plate being lozenge-shaped, whitish and slightly concave on the side of insertion, covered with a convex, polished nearly smooth brown coating on the interior, which is generally worn away by friction toward the center. The small plates are nearly the shape of half the large one partly hollow and without granules. They resemble on the whole, the plates of *P. angulata* Jeffreys as figured by Sars (loc cit., t XII, fig. 10d), but are larger, longer, and more pointed at the extremities. The adult shell comprises about two whorls, maximum length 12·0, max. breadth 9·0 mm. The large plate measures about 4·0x8·0 mm. The axis of the shell is wound in a wide pervious spiral, and the body-whorl viewed from below extends about half way across the base from side to side, and two-thirds the distance from the apex to the front edge. (*Dall*, Blake Gastr., Bull. M. C. Z., xviii, p. 57, 1889).

Off Bahia Honda, Cuba, in 220 fms.; *near St. Kitts* in 245 fms., sand; *off Gaudelupe* in 175 fms., sand; *off Dominica* in 372 fms., sand; *off Dominica* 138 fms., *near Barbados* in 118 to 209 fms.

Bottom temperatures ranging from 43° to 64° F.

This seems to be a rather common species from the frequency with which it was taken. It differs entirely from *P. sagra* Orbigny, and is wider and squarer than *P. candeana* Orb., in which, moreover, the spire is represented as visible for two turns at the apex. (*Dall*).

P. PLANATA Dall. *Unfigured.*

Shell resembling that of *P. aperta* Linné, but flatter, smaller, more quadrangular, with a shorter and smaller body whorl, more polished surface, and with an impressed spiral line near the apex which extends to the margin, where it marks a slight sinus, behind which the posterior margin is prolonged into a rounded prominent point. The shell is brilliantly polished and smooth except for lines of growth, but near the apex are a few microscopic faint spirals invisible without a lens. The spire is wholly immersed and makes in all about one and a half turns. The ventricular plates are formed like those of *P. infundibulum*, and not like those of *P. aperta*. The outer surface of the right plate has two longitudinal blackish lines. The two small plates are somewhat more arched than in *P. infundibulum*. The inner or triturating surface is similar in both. The length of the largest shell observed is 11·5 and its breadth 9·0 mm.

The soft parts are in general much the same as in *P. aperta*, but the cephalic lobe extends farther back and the foot is rounder, flatter and less rolled up at the sides. As seen from below the body whorl of the shell equals only about one-sixth of the total width.

Off Dominica in 138 fms.; *off Barbados* in 140 to 209 fms., bottom temperature 50° to 56° F.

The species is readily distinguished from any other of the group by the posterior point, which, though smaller, recalls that of *Chelidonura* Adams. The soft parts, however, have no resemblance to the very peculiar figure of Quoy and Gaimard. *P. amabilis* Verrill is much nearer *P. aperta*, from which, as far as the shell is concerned, it chiefly differs by being a little narrower than the average *aperta*. The species are, however, quite variable in this respect. (*Dall.* Blake Gastr., p. 58).

P. SAGRA d'Orbigny. Pl. 4, figs. 61, 62, 63.

Shell oblong, thin, fragile, loosely spiral, depressed, wide and truncate below, rather narrowed and truncate above; covered with spiral lines of small oblong rings placed end to end, alternating with a waved stria following the intervals of the rings, and giving the appearance of a chain (fig. 62); spire embraced, not umbilicated, but forming a projecting disk. Aperture very wide, the interior of all the whorls visible therein; lip thin, crenulated. Uniform white. Alt. 3, diam. 1½ mill. (*Orb.*).

Martinique on the strand (Candé); *St. Thomas* (Riise); *off Hatteras* 15 fms. (U. S. F. C.).

Bulla sagra ORB. Moll. Cuba, i, p. 123, pl. 4, f. 5–8, (1841).—*Philine sagra* MORCH., Mal. Bl., xxii, p. 175.—VERRILL, Tr. Conn. Acad., vi, p. 467, pl, 45, f. 16, 16*a*.—DALL, Cat. Mar. Moll. S.-E. U. S., p. 88, pl. 41, f. 16, 16*a*.

P. AMABILIS Verrill. *Unfigured.*

Shell very thin, diaphanous, delicate and shining with bright iridescence; very large for the genus, and very open, showing the interior of the spire, broad oblong, with rounded ends; outer lip evenly rounded posteriorly and scarcely projecting beyond the spire; apex occupied by a shallow pit. Sculpture, conspicuous wavy lines of growth and microscopic wavy spiral striae over the whole surface. Length of shell 15, breadth 10 mill. Odontophore with a large hook-shaped inner lateral tooth on each side, and a slender spiniform outer one. Gizzard large, with three calcareous plates. Station 876, several living specimens. (*Verrill*, Amer. Journ. Sci. [3], xx, p. 398).

Off Martha's Vineyard, in 120 fms.

P. CANDEANA d'Orbigny. Pl. 4, figs. 70, 71, 72.

Shell uniform white, ovate, thin, fragile, much depressed, transversely striate when viewed under a lens; spire very obtuse; whorls 2; columella dilated within, acute; aperture very large, dilated above and spreading. Alt. 12 mill.

Guadeloupe (Candé).

Bullæa candeana ORB., Moll. Cuba, i, p. 119, pl. 4, f. 1–4.—*Philine candeana* MORCH, Mal. Bl., xxii, p. 175.

Section Laona A. Adams.

Laona Ad., Ann. Mag. N. H. (3), xv, p. 324 (April, 1865).

P. zonata A. Adams. *Unfigured.*

Shell dull white, ornamented with two wide transverse red-brown bands; latticed with close, delicate, crenulated longitudinal lamellæ and concentric striæ. (*Ad.*).

Osima and Yobuko, Japan (Ad.).

Laona zonata A. Ad., Ann. Mag. N. H. (3), xv, p. 324, (April, 1865).

This species is type of the group *Laona,* reckoned to be of generic rank by Adams, and thus defined:—

"Shell semiovate, thin, rimate, roughened by lamellose growth striæ; spire concealed; last whorl large and rounded; aperture ample, oblique; roundly-oval; lip receding, arcuate; inner lip simple. The British *Bulla pruinosa* belongs to the same group, which offers the peculiarity of a decussate surface. The form of the shell is also so different from that of any other division of *Bullidæ* that I consider it desirable to point out the significance of these shells by giving them a distinctive name. The animal is unknown."

P. pruinosa Clark. Pl. 4, figs. 73, 74, 75, 76, 77, 78.

Shell oval, tumid, but compressed or pinched in below the apex, more solid than any of its congeners, nearly opaque, glossy in the young only; sculpture, numerous strong and irregular longitudinal wrinkly striæ (fringed at their edges) and finer spiral striæ, which by intercrossing give the surface a reticulated and frosty aspect, or that af lace work; the reticulation is less distinct in full grown specimens; the very young have spiral rows of circular dots as in *P. punctata*; edges of the mouth plain; color white, with frequently a broad tawny band round the middle and a tinge of the same hue on the upper part; these markings are rather evanescent, and appear to be superficial; spire very small, sunk below the apex or crown, which is considerably thickened; whorls 2½. irregularly twisted and indistinct; suture deep and excavated; mouth oval, contracted above by the periphery and inflexion of the outer lip; curved below; it occupies about two-thirds of the under surface; outer lip flexuous, widely indented in the middle, and bending inwards above; edge often thick; the top slightly exceeds the crown

in height; outer corner rounded; inner corner receding and acute angled; inner lip broad and rather thick on the upper part, occasionally forming in the middle a tooth-like process or fold (in one specimen converted into a cluster of minute pearls), behind which is a distinct umbilical groove or depression. (*Jeffr.*).

Alt. 6 mill.

Northern British Seas; Norway.

Bulla pruinosa Clark, Zool. Journ., iii, p. 339.—*Philine pruinosa* Forbes & Hanley, Hist. Brit. Moll., iii, p. 549, pl. 114f, f. 1, 2.—Jeffreys, Brit. Conch., iv, p. 454; v, pl. 96, fig. 6.—Sars, Moll. Reg. Arct. Norv., p. 301, pl. 18, f. 8*a*, *b*, *e*.—*B.* (*Philine*) *pruinosa* Ad., in Thes., p. 600, pl. 125, f. 162.—*P. pruinosa* Sowb., in C. Icon. f. 10.—*Laona pruinosa* Ad., Ann. Mag. N. H. (3), xv, p. 324.—*Philine granulosa* M. Sars, *teste* G. O. Sars.

The latticed sculpture distinguishes this species from others of the N. Atlantic.

Var. *dilatata* Jeffreys. Nearly smooth, more expanded and somewhat angular at the sides, and abruptly attenuated towards the crown. Alt. ·75, diam. ·05 inch. (*Jeffr.*).

Section Johania Monterosato.

Johania Monts., Nomenclature Generica e Specifica di alcune Conchiglie Mediterranee, p. 147, type *B. retifera* Forbes=*B. vestita* Phil. (1884).

P. vestita Philippi. Pl. 4, figs. 66, 67, 68.

Shell oblong, loosely convoluted, tapering towards the spire; lacking transverse striæ; brown, covered with a white net-work; spire truncated, umbilicate. Alt. 10, diam. 6 mill. (*Phil.*).

Palermo and St. Vito (Monts.); *Ægean Sea* (Forbes).

Bulla vestita Phil., Enum. Moll. Sicil., ii, p. 95, pl. 20, f. 4, (1844).—*Bulla* (*Scaphander*) *vestita* A. Ad. in Thes. Conch., p. 574, pl. 121, f. 48.—*S. vestita* Sowb. C. Icon., f. 7.—*Bulla retifer* Forbes, Rep. Æg. Invert., in Rep. Brit. Asso. Adv. Sci. for 1843, p. 187, (1844).—*Philine retifera* Monts., Journ. de Conch., 1874, p. 281.

Peculiar in its netted ornamentation. The name given by Philippi was accompanied by figures. The preface of the *Enumeratio Molluscorum Siciliæ* bears date "August, 1843," while the title page

is dated 1844, so that the volume was probably issued early in the latter year. Forbes' very brief diagnosis has never been illustrated, and was presented at the August meeting of the British Association, the Report of which bears date of 1844 on the title page. While the absolute priority of Philippi's name cannot, perhaps, be proven, it is at least probable; and the mere fact that his type was well illustrated in a standard work on malacology should give his name the preference. The animal is unknown. Monterosato surmises that it may not be an internal shell, on account of the peculiar nature of the outer layer.

Genus? COLPODASPIS M. Sars, 1870.

Colpodaspis Sars, Bidrag til Kundskab om Christianiafjordens Fauna, II, p. 74.—Garstang, P. Z. S. 1894, p. 664 (1895).

"Shell internal or wholly covered by the mantle, bulloid, thin, subglobose-ovate, spire a little projecting, depressed, apex truncate, nucleus simple, not mamillar" (*Sars*). For characters of softs parts see below.

The genus was founded upon a small mollusk of problematic relationship, which Fischer has suggested may be a young *Philine*, which disposition of it was followed on preceding pages (2, 17) of this work. Garstang's work upon a specimen recently captured by him shows it to possess features notably different from *Philine*, and indeed from any *Cephalaspidia;* and his paper has, therefore, been incorporated herein.

C. pusilla Sars. Pl. 21, figs. 1–5; pl. 9, fig. 9.

Shell rimate, very thin, but rigid, hyaline, becoming whitish when dried, subglobose or ovate, smooth; whorls 3, the last one large; spire very short and obtuse; aperture large, oval or subpyriform; lip acute, arched, not impressed, produced and rounded in front; columella nearly straight, about half as long as the shell.

Alt. $1\frac{2}{3}$, diam. 1 mill.

Dröbak, Norway, 70–80 fms. (M. Sars, Aug., 1864); 20 fms. (Sars, June, 1865); *Horten*, 14–20 fms. (G. O. Sars); *near Plymouth, England*, 15 fms. (Garstang, Feb., 1894).

Mr. Garstang's description is as follows:

This Plymouth individual was one-eighth of an inch (3·125 mm.) in length. In color it was snow-white, speckled with opaque white spots. When the animal was inverted, a position which it frequently

assumed in captivity in order to creep, after the manner of so many Nudibranchs, along the surface-film, a large glandular mass of an orange color could been seen through the skin in the anterior part of the posterior prolongation of the mantle, where this organ lay beneath the foot. This glandular mass of an orange color in all probability represents the "rounded brownish-yellow mass" observed by Sars in a similar position and termed by him the liver. The anterior edges of the foot, the dorsal and posterior edges of the tentacles, and parts of the ventro-lateral region of the mantle were ciliated.

The animal consists of a foot, a small tentaculated head, an elevated globose body, and a posterior tail-like pallial appendage.

The Foot.—Sars states that the foot is well developed and of about the same length as the mantle; that in front it is as broad as the mantle, but becomes considerably narrower behind, and terminates in an obtusely rounded extremity. He further states that its anterior edge is divided in the middle by a deep incision into a pair of lappets with rounded extremities. These statements are perfectly borne out by his figures (pl. xi, figs. 1, 4); but comparison with those supplied by myself shows that a somewhat different interpretation must be made of the anterior parts of the foot. The two lappets, which in Sars' figures are shown to be directed forwards, are not really, as he maintains, the divaricated halves of the anterior part of the foot, but are rather to be regarded as a pair of expansions of the antero-lateral margins of the foot, analogous to the anterior horns of the foot in many Aeolids, but differing from the latter in their greater size and obtuse extremities (Pl. 21, fig. 2). Sars' figures also indicate that they are capable of being directed forwards; but I never observed them in this position myself, and must regard the condition represented in my figures as more normal than the former. These antero-lateral processes are so considerable that, in view of the affinities indicated by other organs of *Colpodaspis*, I am strongly inclined to regard them as homologous with those pleuropodial expansions so frequently met with among Opisthobranchiate mollusks. This view receives strong support from the fact that in *Haminea hydatis* of the Mediterranean (which appears to be a different species from the *hydatis* of British naturalists) the pleuropodia, according to Roulé, are scarcely developed except on the sides of the anterior region of the body. Here to judge from Roulé's figure they form elongated obtuse flattened expansions of the foot remarkably like those of *Colpodaspis*, differing only in their greater size and in the power of retro-flexion over the back of the body.

The foot, upon this interpretation, must accordingly be described as T-square shaped, with gracefully arched anterior wings and rounded extremities, and of about the same length as the shell-bearing portion of the mantle. The median furrow of its plantar surface is shown in my drawing (fig. 2) to have the same extent as in Sars' specimens.

The Head.—The grooved tentacles in my opinion correspond with Sars' description, except that no mention is made in the latter of a low curved ridge which can be seen in my figure 1 crossing the anterior part of the head from side to side and connecting the postero-dorsal edges of the two tentacles with one another. The eyes also are much closer together in the Plymouth individual than they are represented to be in Sars' figures; and the statement of the latter that they are situated "close behind and within the base of the tentacles" cannot be said to be applicable in the present case. I do not, however, think that any great importance should be attached to those slight discrepancies.

When *Colpodaspis pusilla* is creeping upon a flat surface, the antero-lateral horns of the foot are just perceptibly in advance of the tentacles (fig. 1); but when the creature is swimming inverted at the surface of the water the tentacles are then seen to be considerably in front of the horns of the foot (fig. 2).

The Body.—I have no addition to make to Sars' account of the body proper, except that in the Plymouth specimen the edges of the pallial siphon were more closely opposed than seems to have been the case with Sars' individuals.

Pallial appendage.—When the animal is creeping upon the bottom of a vessel, a broad flattened tail-like appendage projects behind the mantle and seems at first sight to be the posterior section of the foot. Examination of the animal from the ventral aspect, however, reveals that this appendage is in reality a posterior prolongation of the hinder margin of the mantle to the morphological left of the pallial siphon (fig. 2).

In *Philine catena* also, according to Roulé, the mantle terminates posteriorly in a convex margin, a little below which are two fleshy prolongations, "which can be mistaken for the posterior border of the foot when the animal is contracted." His figures unfortunately do not show this point at all well (pl. i, fig. 25), and Forbes and Hanley's figure, though clearer, does not seem to represent the anatomical relations correctly (l. c., pl. UU, fig. 4.)

In *Philine aperta* the plantar surface also consists both of foot and mantle; but this part of the mantle does not correspond with the pallial appendage of *Colpodaspis*, as it contains the viscera and shell. If it be examined, however, from the ventral aspect, the pallial siphon is seen on the left hand, as in *Colpodaspis* (fig. 2), and to the right of the siphon, the mantle is seen to be prolonged into a short free membranous border, which overhangs the siphonal groove and even extends slightly behind it. The relations of this slight expansion are such that I think it may be regarded as the rudimentary, or probably vestigial, representative of the pallial appendage of *Colpodaspis*.

Radula.—This organ was not described in Sars' original paper, but a figure of it was given (without description) in a later work by G. O. Sars (see pl. 9, fig. 9). There is a single admedian series of sickle-shaped denticles on either side, and two series of slender laterals, the formula thus being 2·1·0·1·2. I was unable to lay open the contracted radula of my specimen, owing to its excessive minuteness; but I determined that the rows in the radula were from 25 to 30, and isolated individual denticles and half-rows by teasing with needle. Some of these are drawn as figure 3 of my Plate. The admedian denticles of this radula differ from those figured by Sars in presenting a sharp distinction between their terminal and proximal parts. The handle of the sickle shows an angular projection from its inner or concave edge, like the corresponding denticle in *Colobocephalus costellatus* as figured on plate 9, fig. 8. The lateral denticles also furnish an additional point of resemblance between the radulæ of these two types in that their points are slightly bent in a plane at right angles to that of their general surface, so that, when the denticles are mounted flat upon a slide, their points are directed upwards towards the observer.

Shell.—Sars has described the shell so accurately that I have nothing to add to his description; but my figures being on a larger scale, represent its form and wonderful delicacy rather better.

Summary.—On the whole, I think this Plymouth specimen presents features which indicate a slight advance on the organization of those described and figured by Sars. I may mention its greater size (3·125 mm. as compared with 2·5 mm.), the greater differentation of the tentacles, pallial siphon, and admedian denticles, and perhaps some increased extension of the free margin of the shell.

Affinities.—Sars was not quite certain whether *Colpodaspis* belonged to the Opisthobranchia at all, and was much impressed by

the fact that the foot is attached to the body by a somewhat narrow stalk—a feature which it shares with most Prosobranchs. Gwyn Jeffreys even informed him that he was inclined to consider *Colpodaspis* as the young of *Cypræa europæa*—a view which now, at any rate, can no longer be entertained.

In spite of our ignorance of the anatomy of *Colpodaspis* we may, however, as a result of the above observations, be certain that *Colpodaspis* is a true Opisthobranch. It resembles various Cephalaspidea in the pleuropodial expansions of its foot (cf. *Haminea*), in the posterior appendage of the mantle (*Haminea, Philine*), in its inflated shell (*Haminea, Utriculus*), and in its radula (*Philine*). On the other hand it resembles the Notaspidea, and differs from the above types of Cephalaspidea, in the great extent of the mantle and in the form of the head and tentacles. In the latter point it again resembles the Anaspidea, for in the young Aplysia, as I have often observed, there is only one pair of tentacles (the anterior one) for a considerable period, and these are grooved just as in *Celpodaspis* and *Pleurobranchus*. These various points of resemblance are all explicable if we regard *Colpodaspis* as a very primitive type of Tectibranchiate mollusk, belonging indeed to the Cephalaspidea, but retaining in an unspecialized condition an unusual number of those primitive characters which the common ancestors of the Cephalaspidea and Notaspidea alike possessed. It supplies an indubitable connecting-link between these two great subdivisions of the Tectibranchia; but it belongs to the group Cephalaspidea, in spite of the inappropriateness of the name, owing to its acquisition of pleuropodial expansions and a posterior pallial appendage—two associated features which are especially characteristic of this group.

The question still remains open whether or not the creature described by Sars and myself has assumed its adult features. Fischer has suggested that *Colobocephalus costellatus* and *Colpodaspis pusilla* are possibly only young stages of *Philine* or of neighboring genera of Tectibranchs, owing to the radula in these two types resembling very closely the radula of certain species of *Philina* (*velutinoides, lima, angulata*). This theory, however, is in my opinion, altogether untenable in the case of *Colobocephalus*, which, beyond the radula, presents no particularly cephalaspidean, or even Opisthobranchiate, features. The probability, on the other hand, that the Philinidæ have been derived phylogenetically from a *Colpodaspis*-like ancestor is sufficiently great to render Fischer's view in this case worthy of

consideration. The white color of the body and the early enclosure of the shell by the mantle support this view; but the fact that all the specimens so far taken, which have been captured at such different times of the year as June, August, and February, have been practically identical in structure, and have shown no special approach towards the adult organization of *Philine*, seems to me to render the view improbable. The possession of a similar radula by so different a creature as *Colobocephalus* rather minimizes than supports the view which Fischer has expressed.

Fig. 1, *Colpodaspis pusilla*, from Plymouth. Dorsal view of the animal creeping upon a flat surface; enlarged. F. Foot; M. Mantle enclosing shell; P. Pallial appendage; S. Pallial siphon.

Fig. 2, Ventral view of same, as creeping inverted on the surface-film. Pl. Pleuropodial expansion; T. Tentacles.

Fig. 3, Half row of radula-denticles.

Figs. 4, 5, The shell, much enlarged.

Genus? COLOBOCEPHALUS Sars, 1870.

Colobocephalus M. Sars, Bidrag til Kundskab om Christianiafjordens Fauna, II, p. 56.

Shell subauriform, very thin, submembranous, with inconspicuous epidermis or none; spire small, the suture deep; aperture very large; ends of peristome disunited; columella flexuous; no operculum.

Animal not completely retractile into the shell; head with vertical revolute tentacular processes; no tentacles; eyes sessile on neck; foot with anterior-lateral processes, the sole large and oblong, truncated behind, having a median lengthwise furrow; mantle not reflexed over the shell. Radula as in *Philine*.

A form of problematic relationships, which Fischer surmises may be the young of *Philine*.

C. costellatus M. Sars. Pl. 21, figs. 6–12; pl. 9, fig. 8.

Shell pellucid, colorless, somewhat rigid (when dried ashy-whitish, subpellucid, shining), subglobose, wider than high; whorls 3, the last large, ornamented with low, narrow, longitudinal, somewhat sigmoid riblets. Spire very short and obtuse. Aperture longitudinal, ovate; columellar lamina very thin, revolute over the wholly covered umbilicus, then visibly narrowed, produced, and continued

in the outer lip which is acute, very thin, arcuate and in the middle subimpressed; posteriorly it is produced in a rounded lobe, separated from the body of the shell by a profound sinus.

Alt. 2, diam. $2\frac{2}{3}$ mill.

Dröbak, 70–80 fms.; *Vallö* 200–230 fms.

Colobocephalus costellatus M. Sars, *l. c.*, pl. 11, f. 7–14.

Fig. 6, animal from above, magnified 10 diameters, showing head-processes, anterior lobes of foot (pleuropodia), and truncate tail. Fig. 7, animal from below. Fig. 8, lateral view. Figs. 9–11, the shell. Pl. 9, fig. 8, half row of radula denticles.

Genus CHELIDONURA A. Adams, 1850.

Chelidonura Ad., Thes. Conch., ii, pp. 561, 601.—*Chelinodura* Fischer, Manual de Conchyl., p. 564.—*Hirundella* Gray, Figures of Molluscous Anim. iv, p. 95, type "*H. hirundinaria*" (1850); Guide Syst. Dist. Moll. B. M., p. 193.

Shell concealed in the mantle, small, ear-shaped, thin and fragile, subspiral, composed of one whorl; aperture very large, rounded below, the outer lip produced far above the vertex in a long, acute, curved process.

Animal elongated, the front margin of the head-disk armed with bristle-like sense-organs, its posterior lying over the back in a long tongue-like lobe. Mantle produced behind in two tail-like processes; foot truncate and subauriculate in front, rounded behind, the mantle-appendages projecting behind it; parapodial lobes long, curving over the head-shield and back. Dentition unknown. Type *C. hirundinina* Q. & G.

This genus differs from *Philine* in the more reduced shell, the peculiar sense-organs of the head, the long posterior mantle-processes and brilliant coloration of the animal. The species are from Mauritius and east Australia.

C. hirundinina Quoy & Gaimard. Frontispiece, figs. 15, 10; Pl. 2, figs. 25, 26, 31–35.

Shell small, fragile, entirely open; white; right margin flat, winged, acute posteriorly.

This singular *Bulla* is an inch long. The head presents three little bunches of short bristles in front. The posterior appendage, bifurcate in the other species, has no lobes, but ends in a simple lanceolate tongue, extending over the back. A transverse

groove separates the posterior part of the body, which terminates in two long filaments resembling the tail of a swallow. Mantle [parapodial lobes] reflexed on each side, embracing head and body. Color so dark that the eyes are not visible. The shell, contained in the thickness of the mantle, is very small, thin, very open, slightly spiral. Gill placed far back on the right side, forming the arc of a circle, with its ramifications on the convex side. Ground-color very deep blue; top of the head, back, median line of posterior tails and mantle-edge have a line of greenish-blue or emerald. One individual out of forty has a whitish cross on the back, and all the blue lines are edged with a line of gold.

Isle of France, (Mauritius); Fouquets, at low water.

Bulla hirundinina Q. & G., Zool. de l'Astrol. p. 367, pl. 26, f. 20–25.—*B. (Chelidonura) hirundinina* A. Ad., in Thes., ii, p. 601, pl. 125, f. 167, 168.—*Chelidonura hirundinina* Martens in Möbius' Reise nach Mauritius, p. 305, pl. 21, f. 5, 6.—*Hirundella hirundinaria* Gray, Figs. Moll. Anim., p. 95.

The specimens collected and drawn by Prof. Möbius are described as follows (pl. 2, figs. 31–35):

When creeping 25 mill. long. Head with three low lobes, the middle one lower than the others, behind prolonged in a tongue-shaped lobe which lies over the back as far as the region of the heart. The posterior segment of the body is higher and broader than the head. It extends in two acute, laterally compressed appendages, which are outwardly convex, inwardly concave; the left appendage is larger than the right. The foot has lateral lobes which extend up over the back to the median line or lap over a little. One specimen (fig. 31) was brownish-black; the head brownish-red above, with an encircling red marginal line. On the back were two long, brown tracts, bounded by red lines. The posterior body also has a brown middle tract bounded by red, extending in two points upon the terminal appendages, and two lateral tracts. Along the red lines run blue-green lines. On the head there is a triangular yellow-white spot with fine black dots. A smaller lunate spot of the same color is on the hind end of the tongue-like head-lobe, and behind this a similar, larger spot on the back. Below and in front of the latter the heart was seen to pulsate.

A second specimen (fig. 32) was bluish-black with yellow spots, more numerous on the back than on the ventral side; the reflexed foot-margins on the back having a narrow clear green edge.

The snail crawls slowly, the posterior appendages usually being dragged straight out behind. On the front of the head on each lateral lobe and the neighboring sinuses stood numerous peculiar sense organs, appearing under the lens like bunches of bristles. They consist of flexible conical tubes (fig. 34, x 25, and figs. 33, 35, x 300) on the blunt distal ends of which is a bunch of many fine hairs. The free end of the tubes can be drawn in. Under the base of the bunch of hairs is an egg-shaped ganglion (fig. 35) in which a nerve ends. The free end of the tube is exserted apparently by its circular muscles, or perhaps by ingress of blood.

C. ADAMSI Angas. Vol. XV, pl. 59, fig. 14.

Head furnished in front with a short silky fringe; mantle terminating behind in two long bifurcate filaments, foot elevated on each side, embracing the head and mantle, rounded both in front and behind; color velvet-black, with a white crescent on the hinder part of the mantle; the head and the outer edge of the foot are bordered with a line of brilliant blue; a line of the same color, bifurcated in front, extends down the back, and the posterior filaments are ornamented in the middle with a similar line; parallel with these blue lines, and at a short distance from them, are lines of a gold color; and spots of the same appear above the white crescent on the back, and at the bifurcation of the posterior filaments. Shell internal, very small, thin, flat, with the right border terminating in a point. Length 2 inches. (*Ang.*).

Rock-pool at low water at Vancluse Bay, Port Jackson.

C. adamsi ANG., P. Z. S., 1867, pp. 116, 227, pl. 13, f. 32.

This species may be identical with the individual alluded to by Quoy as having been met with at the Mauritius among numerous specimens of his *Bulla hirundinina*, but which was not described by him. I have named it in honor of my friend, Mr. Arthur Adams, the founder of the genus *Chelidonura*. (*Angas*).

Genus CRYPTOPHTHALMUS Ehrenberg, 1831.

Cryptophthalmus EHRENB. Symb. Phys. Evert.

Shell internal, minute, white, fragile, the left margin incurved in the middle, but not enrolled; body whorl expanded, produced in a pointed process above.

Body elongated; head shield small, truncate in front, bilobed behind, bearing minute, sessile eyes on its anterior surface; foot as

long as the body, its sides produced in large parapodial lobes which fold over the back. Gill small, projecting backward from under the shell on the right. Male orifice near the foot edge on the right side in front. Female orifice in front of the gill, below the tubular anal opening. Dentition unknown. Type, *C. smaragdinus* Leuckart.

C. SMARAGDINUS Leuckart. Pl. 6, figs. 29–36.

The animal is beautiful emerald green mingled with light green marking. The shell is 8 mill. long, covering the gills, and covered by a delicate mantle-layer. It is fragile, thin, translucent, white. The side margins are only slightly curved toward each other, without whorls or columella. The two broad, thick, free lateral parapodial lobes may be reflexed over the back, entirely closing over the gill. The free end of the gill, similar to that of *Aplysia*, may project behind the shell. Tentacles wanting. Head shield distinct, raised, two-lobed behind. In front, above the mouth, there is on each side a small eye, not visible in the specimens preserved in spirit. The body on each side of the head shield and within the parapodial lobes, has a series of short oblique folds. Ventral surface more or less convex. Genital openings and anus as in *Aplysia*. Length of body two inches. In alcohol they measure one inch.

Red Sea at Tor and Suez; Mauritius; Reunion.

Bulla smaragdina RUEPPEL & LEUCKART, Neue wirbellose Thiere des Rothen Meeres (in Atlas zu der Reise im nördlichen Afrika von Eduard Rüppell, Erste Abtheil. Zoologie), p. 26, pl. 11, f. 2 *a-d* (1828).—*Cryptophthalmus olivaceus* EHRENBERG, Symbolæ Physicæ, seu Icones et Descriptiones Animalium Evertebratorum, etc., Decas prima, *Mollusca*, pl. 1, f. II A G.—*B.* (*Crypt.*) *olivacea* A. AD. in Thes. ii, p. 598, pl. 121, f. 56.—*Cryptophthalmus smaragdinus* MARTENS, in Möbius' Reise nach Mauritius, p. 305.

When contracted, the animal assumes a globular shape (pl. 6, fig. 31, anterior view; fig 30, dorsal view). In fig. 36, the lateral lobes are separated.

The nameless species mentioned by von Martens as being near the genus *Cryptophthalmus*, in Beiträge zur Meeresfauna der Insul Mauritius u. der Seychellen, p. 343, pl. 21, f. 7, is a *Haminea*.

C. CYLINDRICUS Pease. Pl. 2, figs. 36, 37, 38.

Shell unknown. Animal elongate, cylindrical, smooth, sides nearly parallel. Cephalic disk short, about one-fourth the entire

length of the animal, depressed, subcordate, triangular, convexly truncate in front, posteriorly separated by a fissure into two lobes, eyes deeply immersed in the cephalic disk, inconspicuous from above, their position being indicated by small pale spots, they can be distinctly seen by turning up the sides of the disk. The lateral lobes closely envelope the body, extending from the head to the excretory tube, the left one overlapping the right; excretory tube at the posterior end of the body, short convolute. There is no groove between the lateral lobes and the locomotive disk. Color dusky olive, margins of the cephalic disk paler than centrally, and foot paler than above. When disturbed, the animal contracts itself assuming a spherical form. Its motions are languid. Station on seaweed in shallow water. (*Pse.*).

Tahiti, on seaweed.

Crypt. cylindricus Pse., P. Z. S. 1861, p. 245; Amer. Journ. Conch. iv, p. 74, pl. 7, fig. 7.

Section Phanerophthalmus Adams, 1850.

Phanerophthalmus A. Ad., Thes. Conch. ii, pp. 559, 599.—*Xanthonella* Gray, Figs. Moll. Anim. iv, p. 95 (1850).

Shell small, white, wholly buried in the mantle; entirely open, the spire indicated by an incurved hook on the middle of the left margin; lip prolonged in a point above.

Animal large, elongated, with foot as long as the body. Cephalic disk short, bearing distinct sessile eyes, bilobed behind; parapodial processes large, reflexed and meeting over the back. Male orifice anterior, female posterior.

The parapodial lobes are rather smaller than in *Cryptophthalmus*, and the eyes more posterior.

C. luteus Quoy & Gaimard. Pl. 2, figs. 27, 28, 29, 30.

Shell small, fragile, white, oval, open, not spiral; right margin sinuous and acute.

Body much elongated, rounded; head shield emarginate in front, rounded at the sides, with two short posterior lobes; foot widened in front, then constricted, rounded behind; parapodial lobes long, curved over the back where they meet in a sinuous groove and a small hiatus behind. Eyes small, black, widely separated. Gill posterior, to the right, not visible externally. A groove joining the genital openings is on the same side. Shell contained within

the back above the gill; it is very small, white; oval, entirely open, without trace of a spire except the hook on the left margin. The lip is prolonged in a curved point above. It is entirely sulphur yellen. Copulation always reciprocal. Length (of shell) 6, diam. 4 mill.

Port Dorey, New Guinea, on Zostera, at low water mark.

Bulla lutea Q. & G., Voy. de l'Astrol. ii, p. 369, pl. 26, f. 40–44.

Family GASTROPTERIDÆ.

Shell wholly covered, consisting of a minute nautiloid, calcareous spire and a large open last whorl of very delicate membrane or cuticle.

Body elongated, the fore part bearing a head shield, hind part nude, short, sack-shaped, the mantle edge conspicuous along the right side. Foot long, its borders produced in extremely wide lateral wings or pleuropodia. Stomach without plates; penis sack not grooved, and with a long prostate.

Radula with the formula 5·1·0·1·5, the teeth as in *Philine*.

This family is characterized by the enormous size of the lateral extensions of the foot, which are used as swimming organs, instead of being folded over the back as they are in the preceding groups. The shell, moreover, is non-calcified, excessively thin and membranous except the minute spire which is white, calcareous and involute. It will be remembered that the young of some other shield headed Tectibranchs use the parapodia for swimming.

Genus GASTROPTERON Kosse, 1813.

Gastropteron J. F. J. Kosse, De Pteropodum ordine et novo ipsius Genera, p. 10 (1813).—Vayssiere, Rech. Zool. et Anat. sur les Moll. Opistobranch. du Golfe de Marseille, i, p. 39.—Bergh, Bull. Mus. Comp. Zool., xxv, p. 201.—Fischer, Journ. de Conchyl., 1890, p. 349.—*Gasteropteron* of some authors.—*Gasteroptera* Blainv., 1825.—*Parthenopia* Oken, Lehrbuch der Zoologie, 1815, i, p. 830.—*Sarcopterus* Rafinesque, Specchio delle Sci., ii, p. 11, (1814).

Generic characters those of the family. Type *G. rubrum*. *Gastropteron* swims rapidly by means of its large parapodial lobes which are used as wings.

Three species have been described: *G. rubrum* Raf. (*meckelii* of authors), of the Mediterranean and ocean coast of France, in which

the head-disk, foot and wings are purple, orange-red or rose, more or less maculated with whitish, head-disk and wings white-edged, sole paler, and mantle with a posterior filament.

G. pacificum Bergh, of the Aleutian Is., which is pale yellow flecked with reddish throughout, the mantle with no filament or flagellum behind, and

G. sinense A. Ad., which has not yet been adequately described, but seems nearest to *G. rubrum*.

G. RUBRUM Rafinesque. Pl. 7, figs. 1–10; pl. 8, figs. 11, 12, 13, 16.

General color varying from red-purple to pale rose, sometimes with some spots of bluish-white; on the periphery of the head-disk and the parapodia there is an iridescent blue border. The ventral surface of the foot proper is always paler in color than the rest of the body. Mantle having a posterior filament. Jaws small. Radula with the formula 5·1·0·1·5. Shell nautiloid, microscopic, calcareous and very hyaline.

Length, 20–24; breadth, 25–30 mill., or smaller.

Mediterranean, Ægean and Adriatic Seas; Archachon basin, Gironde, 50–120 meters.

Gastropteron KOSSE, De pteropodum ordine et novo ipsius genera, 1813, p. 10–16, figs. 11–14.—*Sarcopterus ruber* RAFINESQUE, Quadro dei generi di Moll. Pteropodi, in Specchio delle Sci., ii, p. 11, Nov. 1814; Précis des découvertes somiologiques ou Zoologiques et Botaniques, p. 30 (1814).—*G. meckeli* BLAINVILLE, Manual de Mal. et Conch., p. 479 (1825).—PHIL., Enum. Moll. Sicil., i, p. 124.—SOULEYET, Voy. Bonite, Zool., ii, p. 464, pl. 26.—KROHN, Archiv f. Naturg., 1860, p. 64, pl. 2, f. 2, 3 (larva and shell).—VAYSSIERE, Ann. Sc. Nat., Zool. (6) ix, p. 1–72, pl. 1–6; Rech. Moll. Opistobr., 1re Pt., Tectibranches, p. 40, figs. 35–41.—BERGH, Zool. Jahrb., vii, p. 281–303, pl. 16, f. 1–27, pl. 17, f. 1–10.—*Gastropteron rubrum* FISCHER, Journ. de Conchyl., 1890, p. 349.—*Gasteropteron coccineum* FERUSSAC, Tabl. Syst. p. 25.—*Clio amati* DELLE CHIAJE, Mem. sulla Storia e Notomia degli Anim. senza Vert., i, p. 53–59, pl. 2, f. 1–8 (1823).

The shell-cavity of the mantle is very large, occupied throughout its extent by a delicate, very hyaline membrane, at the posterior part of which is found the small nautiloid shell (pl. 7, fig. 4). The shell is nautiliform, hyaline and translucent, resembling in texture

that of *Carinaria*, with 1½ to 2 whorls, the last one enveloping the preceding, showing under a strong lens very fine growth-striæ. It is situated at the posterior part of the liver, a little process of which projects into its cavity, it is a little behind and to the right of the anus, its convexity turned toward the foot. The delicate membrane mentioned above is adherent to the peristome, and is doubtless a non-calcified prolongation of the cuticle of the shell. It covers all of the dorsal surface of the viscera, part of the sides, and nearly as far forward as the end of the cephalic disk.

A very general view of the viscera is shown in fig. 10 of pl. 7; for detailed description and figures see Bergh, Zool. Jahrb. Abtheil. f. Anat. u. Ont., vii, p. 281, and Vayssiere, Ann. Sc. Nat., Zool. (6), ix, p. 1–72, pl. 1–6. In these excellent monographs, the entire literary history of *Gastropteron* also is discussed.

The jaws are weakly-developed, consisting of two small lamellose plates (pl. 8, fig. 16), one on each side of the median line of the upper part of the mouth. The plates have a mosaic surface, showing the ends of the crowded subcylindrical bodies of which they are composed (pl. 8, figs. 12, 13).

The radula lacks median teeth as in *Philine*. The laterals (pl. 7, figs. 7, 8, 9, three views of one lateral) have the hooked form with a serrate internal crest seen in *Philine*. The uncini (pl. 7, fig. 5, and fig. 6) are also practically as in *Philine*, narrower than the laterals, without serrate crest.

The penis is elongated, cylindrical (pl. 8, fig. 11), lying as usual on the right side of the buccal mass, 6–11 mill. long, usually carmine-red outside, sometimes yellowish-white, red at the apex only; prostate (fig. 11) 3½ to 6 cm. long in the smallest, 8 to 9 in the largest individuals when straightened out.

G. sinense A. Adams. *Unfigured.*

Animal flesh-colored, dotted and netted all over with carmine; body paler, the viscera showing through the sub-pellucid integument; foot lobe large, free, with entire margins, rounded, the surface dotted and reticulate with red. (*Ad.*).

Hulu-shan Bay (Regent's Sword), 3 fms.

G. sinense Ad., Ann. Mag. N. H. (3), viii, p. 139 (Aug., 1861).

I obtained three individals of this species in the dredge from three fathoms of mud. I placed them in a clear bottle of salt water, and observed them some time. Chiaje might well be excused for

regarding the genus as a Pteropod, for, at first sight, it has all the appearance and action of a Pneumodermon. My specimens appeared to want the power of crawling altogether; the animals, after taking short flights, usually upside down, through the water, by butterfly flappings of the side-lobes of the foot, gently alighted and remained stationary on their stomachs, with the swimming-lobes folded together over the back, until ready for another little excursion. The lower surface of this species, moreover, is colored exactly like the fins, and shows no signs of a creeping disk. I believe the genus should be placed in the family Lophocercidæ, or rather, Icaridæ; for Prof. E. Forbes had previously described Lophocercus under the name of Icarus. The Chinese species seems to differ from the Mediterranean Gasteropteron in being covered with crimson punctate and reticulate markings. Other points of difference are shown in my drawings. (*Ad.*).

G. PACIFICUM Bergh. Pl. 8, figs. 14, 15, 17–23.

Living animal yellowish, flecked with red. Margin of mantle without a flagellum. General proportions as in *G. rubrum*, but smaller; foot usually distinctly demarked from pleuropodial lobes, which are smaller and a little shorter. Free margin of the mantle narrower, only behind a little wider, but without trace of filament. On account of the narrowness of the mantle-skirt, the gill is nearly exposed, relatively larger than in *G. rubrum*, directed more downward; leaflets of gill fewer, 16–20, and free ends of the same longer; the black kidney-pore is nearer the anus. Genital openings and semen-groove as in *rubrum*. The shell (pl. 8, fig. 18) is as in *rubrum*, the calcified portion measuring ·6 to ·66 mill., chalk-white, radially striate, and very fragile, the large cuticular last whorl (fig. 19) as in *G. rubrum*. Dentition (pl. 8, fig. 21) as in *G. rubrum*, formula 5·1·0·1·5 or 6·1·0·1·6; laterals (pl. 8, figs. 20, 22) and uncini (pl. 8, figs. 21, 23) offering no especial differential features.

Unalaschka, Aleutian Is., 9–15 fms (Dall.).

G. pacificum BERGH, Zool. Jahrb. vii, p. 303, pl. 16, f. 28; pl. 17, f. 10–26 (1893). Bull. Mus. Comp. Zool., xxv, p. 202, pl. xii, f. 1–2.

Specimens preserved in alcohol still retained part of the original coloration, the head-shield, foot and pleuropodia clear yellowish, with numerous red dots, more or less grouped and more or less close; on the under side and free apex of head-shield they were closer. The posterior body gray, usually, especially in front, strewn with red-

dots, the gills whitish. The individuals were mostly of the same size: length of pleuropodia 7·5 mill., breadth of animal across extended pleuropodia 12 mill., alt. 5·5 mill.

Besides its smaller size and different coloring, the lack of a posterior flagellum on the mantle offers an obvious external difference between this form and *G. rubrum*. For description of anatomy see Bergh, *l. c.*

Family AGLAJIDÆ.

= *Doridiidæ* Bergh *et al.*

Body oblong, with two dorsal shields separated by a transverse furrow, the head-shield having narrow, free lateral and hind margins, posterior shield or mantle produced backward in two lobes or wings. Foot wide, truncated in front and behind, the sides continued in fleshy parapodial (pleurapodial) lobes which stand erect or recurved at each side of body. Shell internal, posterior, consisting of a flat, solute spiral whorl and a minute spire, the inner rim of whorl calcified, outer part membranous. Gill posterior, on right side, large, bipinnate. Buccal mass very large, without jaws or teeth. Penis with a superficial sulcus; prostate gland large.

This family differs from *Philinidæ* and *Gastropteridæ* in the lack of a radula; from the latter family it is moreover distinguished by the more moderate size of the parapodial lobes, which are not used as swimming organs.

The following account is largely abridged from Bergh's two admirable papers on Doridiidæ.

Synopsis of Genera.

Genus Aglaja Renier.

Head-shield without rhinophores or frontal processes.

Genus Navanax Pilsbry.

Head-shield with the front lateral angles produced into rhinophores, as in *Pleurobranchus*.

* * *

Genus AGLAJA Renier, 1804.

Aglaja Renier, Prospetto della Classe dei Vermi, p. 16, (1804); Tav. di Classificazione, 1807, pl. 8; Osserv. Postume di Zool. Adriatica, pubblic. per cura del R. Instit. Ven. a Studio del Meneghini, Venezia 1847, p. 3–8, pl. 16. Not *Aglaja* or *Aglaia* Albers et auct. mult.—*Doridium* Meckel, Ueber ein neues Geschlecht der Gasteropoden, Beytr. Vergleich. Anat. i, zweites Heft, p. 33, (1809), and of authors generally.—*Acera* Cuvier, Mém. sur les Acères, in Ann. Mus. Hist. Nat. Paris, xvi, p. 9, (1810).—*Eidothea* Risso, Hist. Nat. Eur. Mérid., iv, p. 46, (1826).—*Melanochlamys* Cheeseman, Trans. N. Z. Inst., xiii, p. 224, (1881).—*Posterobranchæa* d'Orbigny, Voy. dans l'Amér. Mérid., p. 201, (1837?).—*Bullidium* Leue, Dissert de Pleurobranch, p. 10, (1813).—*Lobaria* Blainville, Manuel de Malac., p. 478, (1825).—? *Philinopsis* Pease, P. Z. S. 1860, p. 21.

For anatomy see Bergh, Die Gruppe der Doridien in Mittheil. Zool. Stat. Neap., xi, p, 107–135, pl. 8, and Bull. Mus. Comp. Zool., xxv, p. 205–222.

See above for characters.

This genus was first indicated by Renier under the name *Aglaja* in his Prospetto, 1804, but it was not characterized until his Tavolo di Classificazione appeared in 1807, in which the group is very well defined, with descriptions and figures of the two Mediterranean species. The name has been generally dropped by malacologists in favor of Meckel's term *Doridium*, published in 1809; but such a course is wholly without justification. There is a genus *Aglaea* in plants (Persoon, 1805), and the name *Aglaja* (and *Aglaia*) has been several times used in zoology, but clearly subsequent in every case to Renier's diagnosis. The other synonyms, *Acera* Cuv., *Eidothea* Risso, *Melanochlamys* Cheesem., etc., are later and absolute synonyms. *Posterobranchæa* Orb, was founded upon an error, the dorsal being mistaken for the ventral surface of the body, reversing the positions of all asymmetrical organs, and bringing the transverse groove of the back below. *Philinopsis* of Pease seems to be another synonym, but in the absence of definite information I have inserted it at the end of the genus *Aglaja*.

Geographic Distribution.

Mediterranean: *A. tricolorata* and *depicta.*

E. coast of Africa: *A. cyanea, nigra, guttata.*

Australia and New Zealand: *A. marmorea, lineolata, cylindrica.*

Japan: *A. gigliolii.*

Sandwich Is.: *A. nuttalli*, "*Philinopsis*" *speciosa* and *nigra.*

W. coast of the Americas: *A. maculata, purpurea, diomedea, ocelligera, adellæ.*

West Indies: *A. punctilucens* and *gemmata.*

The genus is not known fossil.

A. TRICOLORATA Renier. Pl. 1, figs. 10, 11; pl. 14, f. 81. pl. 13, figs. 71, 72, 73, 74, 75.

Back of the body and outer surface of pleuropodial lobes chestnut-brown or coffee colored, *with round snow-white pearl-like dots;* border of dorsal shield aud pleuropodia marked with a narrow blue band, inside of which is an orange band. Posterior body lighter than the anterior; sole velvety-black with a bluish luster, with some small white dots in front and behind. *Mantle with two deeply separated lobes behind, the left one always provided with a flagellum* or filament (pl. 1, figs. 10, 11). Length 4–5 cm., breadth with spread parapodia 2·5–2·8 cm.; alt. to apex of frontal shield 1·6–1·9 to 1·3–1·5 cm.

Specimens in alcohol retain the coloration remarkably well, but contract much, length 3 cm.

Shell (pl. 14, fig. 81) proportionately smaller than in *A. depictum,* less concave; milk-white in the middle, more or less translucent toward the edges; nucleus consisting of one whorl, the second whorl forming all of the dilated portion of the shell.

Mediterranean Sea.

Aglaja tricolorata RENIER, Tav. di Classificazione pl. 8, (1807); Oss. postume di Zool. Adriat., 1847, p. 5, 7, pl. 16, f. 12, 13.—*Doridium tricoloratum* BERGH, Mittheil. Zool. Sta. zu Neapel, xi, p. 111, pl. 8, f. 1–10; Bull. Mus. Comp. Zool., xxv, p. 208, pl. 12, f. 4.—*Doridium meckelii* DELLE CHIAJE, Mem. i, 1823, p. 117-123, 133, 135–136, pl. 10, f, 1–7.—CUVIER, Regne Anim. 2d edit., iii, p. 64.—CANTRAINE, Malac. Medit., p. 74.—*Acera meckelii* PHIL., Enum. Moll. Sicil. ii, p. 93.—*Doridium membranaceum* Meckel VAYSSIERE, Ann. des Sciences Naturelles Zool. (6), ix, p. 73 et seq., pl. 7, f. 56, 57, 59–67; pl. 8, f. 68, 69; Rech. Moll. Opistobr., p. 48–49, pl. 2, f. 45–47.

Besides the differences in the shell and coloration, this species differs from *A. depicta* in having two deeply separated lobes on the

hind edge of the mantle, the left one bearing a flagellum. The head disk is smaller and more trapezoidal than in the other Mediterranean species. The foot occupies the front three-fourths of the entire length of the body.

A. DEPICTA Renier. Pl 12, figs. 63–70; pl. 1, fig. 12 (x 7); pl. 13, f. 76, 77.

Back of the body and outside of pleuropodial lobes chestnut, brown, blue-gray or violet-black, maculated and marbled with white. Head-shield and lateral lobes edged with two narrow stripes, one blue, the other yellow. *Head-shield with two short stripes of buff in front.* Sole velvety-black or violet-brown, sometimes ornamented with whitish spots. Gill orange or pale brownish. *Posterior lobes of mantle joined, the left one with no flagellum.* Length 35–60 mill.

The shell (pl. 12, f. 63, 64, 68, 70; pl. 1, f. 12) is not so different from that of *A. tricolorata* as would be thought from the figures; but the small spire is more solute, and the projecting process is smaller; the large thin outer whorl shows 2 or 3 more or less distinctly marked growth-zones; this quite cuticular, pale yellowish part is in some individuals, especially the younger ones, more or less calcified, excepting always the anterior part; in the large individuals it was completely cuticular. Diam. from edge to edge across spire, 7–12 mm. In a large individual, length 55 mill., the the shell measured in greatest length 16½ mill.

Mediterranean Sea.

Aglaja depicta RENIER, Tav. di Class., 1807, pl. 8; Oss. Posthume, p. 4, 7, pl. 16, f. 1–11.—*Doridium depictum* BERGH, Mittheil. Zool. Stat. Neap., xi, p. 123, pl. 8, f. 11–13, 17; Bull. Mus. Comp. Zool., xxv, p. 209, pl. 10, f. 9; pl. 12, f. 3.—*Doridium coriaceum* and *D. membranaceum* MECKEL, Beyträge zur Vergl. Anat. i, 2te Heft, p. 33, (1809).—*Acera carnosa* CUVIER, Mém. sur les Acères, Ann. Mus. H. N. Paris, xvi, p. 9–12, 14–15, pl. 1, f. 15–20, (1810)—*Doridium carnosum* DELLE CHIAJE, Mem. sulla Storia e Notomia, etc., i, pl. 76, f. 9–11; pl. 107, f. 2.—VAYSSIERE, Rech. Moll. Opistobr., p. 45, pl. 2, f. 42–44.—*Doridium aplysiaeforme* DELLE CHIAJE, Mem. ii, p. 185–192, pl. 13; t. 80, f. 23, (1825).—*Acera aplysiaeformis* CANTRAINE, Malac. Medit., p. 74.—*Eidothea marmorata* RISSO, Hist. Nat. Eur. Mérid., iv, p. 46, pl. 1, f. 9.—*Doridium marmoratum* CANTRAINE, Bull. de l'Acad. Roy. des Sci. de Bruxelles, 1835, ii, p. 386. —*Acera marmorata* CANTRAINE, Mal. Medit. et Lit., p. 73, pl. 2, f. 2.

This species seems to be variable in coloration like the preceding, and even to a greater degree. The snow-white pearl-like spots of *A. tricolorata* which are so conspicuous, seem to be represented in this form by more irregular white spots. The posterior wings of the mantle have an entirely different form from those of *tricolorata*, and pass into each other bow-like at their bases. There is never a flagellum on the left wing. The shell resembles that of *tricolorata*, but the spire is more free, and the cuticular part of the shell is larger. The colors seem to be well retained in alcohol.

A. CYANEA v. Martens. *Unfigured.*

In life uniform blue or with small round yellow spots. Spirit examples blackish with pale spots, covered with numerous net-like anastomosing wrinkles. 50 mill. long; head-shield 26 mill. long. Breadth with parapodia turned up 26, with them spread out 43 mill. Distinguished from the Mediterranean species by the proportionally smaller length of the head-shield. (*Mart.*).

Inhambane, E. Africa (Peters).

D. cyaneum MART., Monatsber. K.-P. Akad. Wissensch. zu Berlin 1879, p. 738 (1880).—*D. cyaneum* var. *vittatum* MART., Beitr. zur Meeresfauna Mauritius, etc., p. 305.

It is called by the natives *miguedua*, which signifies *sleeps not.*

Var. VITTATA Martens.

Living animal 7 cm. long, 3–4 cm. wide. Back brown with brimstone-yellow spots; on the head two brown-yellow longitudinal lines, on the back two brown-yellow spots. Foot-edges, head and mantle edged with blue and yellow; sole bluish-brown. In the single spirit specimen the brown-yellow longitudinal bands on both sides on head-shield and on foot-margin have been well retained, but not the spots on the back. (*Mart.*).

Fouquets, Mauritius (Möbius).

A. NIGRA v. Martens. *Unfigured.*

Living animal black with clear yellow and orange-yellow spots and bands, and indigo-blue edges, the spots sometimes very sparse. Spirit examples 19 mill. long, 8 mill. wide with the parapodia turned upward, 15 with them spread out. Head-disk 10 mill. long, granule-wrinkled. Internal shell strong, chalky. (*Mart.*).

Querimba Is., E. Africa (Peters).

D. nigrum MARTENS, Monatsber. K.-P. Akad. Wissensch., 1879, p. 738 (1880).

The name of this species must be changed if, as I suspect, *Philinopsis nigra* of Pease proves to be an *Aglaja*.

A. GUTTATA v. Martens. *Unfigured.*

Living animal 4–5 cm. long, 2½–3 cm. wide. Head and back brown, with close isabella-yellow flecks in which are brown dots or lines. Sole bluish-brown with yellow flecks, the margins blue and yellow. Perhaps only a variety of *D. cyaneum* v. *vittatum*. (*Möbius*).

Spirit examples pretty clear gray-brown, head-shield and back with dark-red-brown spots, veins and dots; foot darker, with numerous isabella-yellow roundish spots. The head-shield is (in spirit examples) as long or longer than the posterior body, and is coarsely granulated rather than wrinkled, in *D. cyaneum* v. *vittatum* it is shorter and more wrinkled longitudinally. (*Mart.*).

Fouquets, Mauritius (Möbius).

D. guttatum MARTENS, Beitr. zur Meeresfauna der Insel Mauritius u. der Seychellen, p. 306 (1880).

A. MARMORATA Smith, Pl. 1, figs. 1, 2, 3, 4, 5.

Animal (in spirit) blackish, copiously mottled with a dirty buff color. Cephalic disk longer than wide, rather narrower in front than behind, with a thickened two-fold margin anteriorly and at the sides, more expanded and simple posteriorly. Hinder dorsal disk a little shorter than the front one, lobed posteriorly on each side, with an intermediate sinus, with a free margin at the sides, but not in front, where it is covered by the hinder free extension of the cephalic disk. Viewed posteriorly, the animal is truncate, terminating in a curved expansion of the dorsal disk on each side which conceal the gills beneath them. Foot extending the whole length of the animal, with a duplex margin in front below the mouth and for a short distance along the sides, and then simple and gradually increasing in the width of the expansion towards the end, where it is very wide beneath the branchia; it is stained with black on the inside of the edge. Branchial plume posterior, concealed beneath the foot and the hinder lobes of the dorsal disk. Head presenting exteriorly a small lobe on each side the oral opening.

Shell internal, situated at the hinder extremity above the branchia, white, calcareous, uncoiled, consisting of one or two volutions, thickened at the free "sutural line," convex externally and concave within, cup-shaped at the commencement, with the outer edge extended by a broadish membranous expansion. Total length 33 millim.; cephalic disk 18 long and 16 wide at the broadest part; shell with a greatest diameter of 8 millim.; and about 2 in height. (*Smith*).

Thursday Island, Torres Straits, 4–5 fathoms, on a sandy bottom. (Coppinger).

Doridium marmoratum Smith, Zool. Coll. 'Alert,' p. 87, pl. vi, f. I–I 4 (1884). Not *Doridium marmoratum* Cantraine, 1835.

The only species which appears to have been recorded from the Australian coasts is Aglaia lineolata, figured by H. & A. Adams in the Genera of Recent Mollusca, vol. iii, pl. 58, fig. 4. This differs, however, in the form of the anterior dorsal disk and its small size in proportion to the hind part of the animal in addition to which the color and markings appear to be quite distinct. *Aglaia gigliolii*, from Japan, described by Tapparone-Canefri (Voy. Magenta, p. 110, pl. 1, fig. 18), may be distinguished by the posterior lobation of the cephalic disk, different color, and apparent different position of the branchial plume.

Doridium cyaneum, *D. nigrum*, and *D. guttatum*, described by Dr. Von Martens from the Indian Ocean, have not yet been figured. Until all these exotic species have either been compared or much more amply described and illustrated, there will remain much uncertainty respecting the identification of all or any one of them.

A. lineolata H. & A. Adams. Pl. 1, fig. 7.

No description of this species has been published, to my knowledge. As figured by A. Adams, the shields and outside of parapodia are transversely lineolate with purplish on a light brown ground; insides of parapodia very dark; posterior wings of mantle short, without a filament. Shell unknown.

Australia (Gould).

Aglaia lineolata H. & A. Ad., Gen. Rec. Moll. ii, p. 27, iii, pl. 58, f. 4.

A. cylindrica Cheeseman. *Unfigured.*

Body elongated, almost cylindrical, 1–1¼ in. long; color a deep rich velvety-black. Cephalic disk narrow, oblong, quadrate, slightly

expanded in front, so as to project over the foot and mouth, truncate behind. Mantle small, entirely concealing the shell, at its posterior end 2 lobed and with a large gaping orifice. Foot large with ample side-lobes, which are folded up to the sides of the head-disc and mantle, leaving, however, the back exposed. Shell quite internal, triangular, spire minute, inner lip with a small spoon-shaped projection. Branchiæ minute, situated far back on the right side under the mantle. Gizzard very large and muscular, without calcareous plates. Odontophore apparently wanting. I assume that the proper position of this animal is with the *Philinidæ*, with which it agrees in most of its characters. It differs, however, in having no odontophore, and in the gizzard not being strengthened with calcare, ous plates. Aglaia (of Renier), appears to be its nearest ally; but I am unable to place it in that genus, as it differs from the species figured in Adams' "Genera" in being much more elongated, in the cephalic disc being larger and projecting beyond the foot, in the branchiæ being smaller and always concealed by the mantle, and in the side-lobes of the foot being closely appressed to the side of the animal, and not spreading.

Auckland Harbor and near Dunedin, New Zealand, in tide pools.

Melanochlamys cylindrica CHEESEMAN, Trans. N. Z. Inst. xiii, p. 224 (1881).

A. GIGLIOLII Tapparone-Canefri. Pl. 1, fig. 6.

Body oblong, as much as 32 mill. long, 12 mill. wide; head-shield ovate-oblong, large, more or less bilobate behind; posterior body smaller, subquadrate, deeply bilobed behind; side margins (parapodial lobes) free, very narrowly edged with brown. Foot ovate, large, wider than dorsal lobes. Color of specimens preserved in alcohol buff-white, irregularly reticulated with brown and ashy, the head-shield having a median longitudinal pale line. Shell internal, delicate, vitreous, very transparent, resembling that of *D. carnosum* in form.

Japan.

Aglaia gigliolii T.-C., Zool. Viag. Magenta, p. 110, pl. 1, f. 18 (1874).

A. NUTTALLI Pisbry, n. sp. Pl. 6, figs. 37, 38.

Alcoholic specimen uniform black-brown above, sole the same color, but with faintly discernable sparse light maculation. Head-

disk (much fore-shortened in figure) oblong, wide, emarginate in front, subtruncate behind; free lateral margins 2–3 mill. wide, posterior free margin wider. Posterior wings of mantle very large, long, thin, the two membranous lobes broadly united by connecting web, the left lobe bearing a short, flat flagellum. Gill (pl. 6, fig. 38, seen from below) 11 mill. long (curved), with 11–12 branches on each of the rhachis, alternately arranged, the branches on the convex side nearly double as long as those on the concave side of rhachis. Total length 40, breadth 20 mill. Length of head-shield measured direct from front to back margin, 22 mill.

Sandwich Is. (Nuttall).

The great development of the posterior wings and the flat filament of the left one are characteristic. It differs from *A. tricolorata* in having the tail-lobes broadly united, and the gill of different structure if Vayssières figure of the gill of that species be correct. Description from one specimen; shell not seen. Color in life unknown. Fig. 37 is accidentally inverted.

A. MACULATA d'Orbigny. Pl. 6, figs. 40–43.

Anterior and posterior disks of body black-brown; posterior mantle-wings greenish-brown with some small yellow spots; foot (fig. 43) greenish-brown with many unequal rounded spots of sulphur-yellow; outside of parapodia the same color but spotless.

Body thick, rounded; back smooth, the anterior shield wide and truncate in front; posterior shield oval, smooth, terminating in thick fleshy lobes, the right one wider. Foot fleshy, plicate, striate and ridged transversely, smooth in front and distinctly emarginate. Gill pyramidal, symmetrical, composed of a great many leaflets bilobed at their ends.

Length 3, width 2 centimeters.

Valparaiso, Chili.

Posterobranchœa maculata D'ORB., Voy. dans l'Amer. Mérid., p. 203, pl. 17, f. 6–9 (not f. 10).

The view already expressed by Mörch and Fischer in regard to d'Orbigny's error in mistaking the back for the foot of this mollusk, is undoubtedly correct. When this is righted, we find the characters of *P. maculata* perfectly normal for the genus *Aglaia* or *Doridium*.

A. PURPUREA Bergh. Pl. 13, fig. 78.

Living animal blackish-purple. Much contracted individual in alcohol is dark brownish, almost black in color, on the anterior shield; the hind body dirty reddish-brown; both quite finely punctate with yellow. The sides of the body as well as the lower half of the upper side of the foot-wings (parapodia) yellowish-brown, while the upper half of the parapodium is paler and vertically striated, as is also the hind half of the upper side of the tail. Gills dirty yellow; the hind wings of mantle quite black, finely punctate with yellow and with lighter margin. Entire under surface of animal, with the outer (under) side of the parapodia black, finely punctured with yellow. The length, to base of posterior wings, 3·8 cm., alt., 2·8, breadth, 3·2. The length of head-shield is 2 cm., that of posterior wings 1·2 cm. Length of the contracted gill 1·5 cm.

Form most as in *A. depicta*. Posterior wings bound together continuously above, the left one without a flagellum; their margins were, perhaps, somewhat notched. The peculiar spot in front under the margin of the anterior shield could not be discovered. Gill yellowish.

Shell without trace of calcification, horn-yellow, on anterior margin quite colorless, thin, only on the back margin a little thickened. Form as usual, the spire not solute, its continuation downward and forward not large, the extension of the last whorl backward not long, transverse diameter of the shell about 13 mill.

Catalina Island, California, (Dall, 1874)

Doridium purpureum Bergh, Mus. Comp. Zool., xxv, p. 209, pl 12, f. 7.

The figure represents the penis-sack (dark portion) and its prostate (light portion).

A. DIOMEDEA Bergh. Pl. 1, f. 14; pl. 15, fig. 95.

Largest specimen measures, length, 10, breadth 6; alt. 5 mill. others measure 7 x 5 x 4½. Color dark brownish-black, with sparsely strewn whitish and yellowish flecks on the back, foot and outside of parapodia; side margins of posterior shield dirty light yellowish; sides of body and furrow between anterior and posterior shields, bluish-gray; upper side of foot-wings and the upper side of tail grayish, the gill yellow. Color in life said to be nearly black. Form as usual. Back shield somewhat longer than the head-shield; no trace of olfactory organ discoverable. Hind wings of mantle

contracted, seeming to be not much developed, not connected above, pretty rigid, with round hind end, the left one lacking a flagellum.

The shell was of peculiar form, relatively larger and longer than in other species, in the largest individual 5 mill. long, 3·4 broad. It was entirely calcified, relatively thick, somewhat thinner in front, and more yellowish there, otherwise chalk-white. The spire small, not free; the process directed forward and downward large, the hollow in it adjacent to spire pretty deep.

Kadiack Is. (*St. Paul*) *Bering Sea*; *Yukon Harbor, Shumagin Is.*, 6–10 fms. (Dall, Aug., 1874).

Doridium diomedeum Bgh., Bull. Mus. Comp. Zool., xxv, p. 211, pl. 11, f. 1.

Readily recognizable by its coloring and peculiar shell.

A. ocelligera Bergh. Pl. 14, figs. 82, 83, 84.

The single individual was rather contracted, 12 mill. long, 9 wide, and 9 mill. high. Color of shields and outside of parapodia gray-brown with a multitude of whitish round flecks. Remains of a lighter border of shields and parapodia could be distinguished, and also on margins of the flagellum. The under side of the foot blackish with sparsely strewn whitish flecks. Gill yellowish. Living animal said to be black-purple with yellow spots.

Proportions as usual. The hind margin of anterior shield very strongly produced (3¼ mill.); the posterior wings of mantle quite separated, the left lobe prolonged in a flagellum 1 mill. long (pl. 14, fig. 84). The shell measures 4 mill. in breadth (across the spire), is strongly calcified, alabaster-like, with only a narrow yellowish cuticular margin anteriorly. Spire somewhat projecting, the process running forward and downward pretty strong, deepened at its base; the right part of the shell stronger, especially more behind. Penis (pl. 14, fig. 83) dirty yellow, 4–5 mill. long; glans with a strong furrow, the apex sticking out of penial opening. Prostate strong, a little longer than penis, of the same color, its end forked (f. 83).

Sitka Harbor, 15 fms. (Dall, May, 1874).

Doridium ocelligerum Bgh., Bull. M. C. Z., xxv, p. 212, pl. 10, f. 10; pl. 12, f. 5–6.

A. adellæ Dall. Pl. 9, figs. 17, 18, 19, 20, 21, 22.

Animal naked, about 16 mm. long, of a dark plum color, mottled with fine vermiculate spots of golden yellow; general form that of

D. carnosum Cuvier, but with a shorter head-shield, half as long as the body and transversely truncate behind; the posterior free portion of the mantle short, obscurely bilobed, and without a flagellum; front edge of the head-shield slightly excavated; parapodia wide; the sole slightly longer than the body; shell (figs. 17–20) internal, subconical, white, covered with a brownish epidermis; pillar strong, reflected with a deep groove outside of it, the basal end projecting spur-like; nucleus small, depressed. (*Dall*).

Eagle Harbor, Puget Sound, 30 fms. (Young Naturalist's Society).

D. adellæ Dall, The Nautilus, viii, p. 73 (Nov., 1894).

The shell is more conical and the cycloid wall of it narrower than in *D. carnosum*, and the excavated pillar much more prominent. See Ann. Mus. de Marseilles, Zool. ii, p. 45, pl. 2, figs. 42–44, 1885. (*Dall*).

A. punctilucens Bergh. Pl. 14, fig. 85.

Founded upon two individuals in the Copenhagen Museum. In color they agree almost completely. The dorsal shields are dirty light yellow marbled with black, marked with quite fine brownish lines (much finer than those of the ventral surface), and over this are strewn emerald-green dots, especially on the head-shield and most on its anterior margin. The margins in one individual shine through greenish-gray with whitish dots; in the other darker, quite blackish with yellowish dots. The wings or posterior lobes of the hinder shield are marbled gray and black, with numerous whitish dots and little spots, especially on the posterior side. The marginal part, especially above, grayish-green, finely white-dotted or darker. The sides of the body and the inner surface of the parapodial wings are brownish-gray or darker, dotted with yellowish. Gill yellowish. The sole as well as the outer surface of the parapodial lobes of alternate narrow, light dirty yellowish and brown longitudinal lines, the latter in large part showing rows of small spots or still finer lines of a yellowish color. The edge of the parapodial wings, especially on the inside, are greenish-gray, punctate with whitish, or quite blackish, punctate with yellowish. The largest individual (from Guadeloupe) measures, length nearly 28 mill. (to posterior edge of posterior lobes) breadth 12, alt. 10 mill.; length of head shield 11½, of the hind body 12½, and its wing 6 mill. Length of the gill 7 mill.

The form is practically the same as in the other species. Head-shield somewhat emarginate in front, sides and posterior edge strongly projecting. The lateral margins of posterior shield also project strongly, especially behind. Surface of the shields quite even. The posterior mantle-wings are strongly developed, bound together above by a strongly produced middle piece, stronger than in *A. depicta*. The wings are similar to that species, but more produced, without flagellum.

Shell (pl. 14, fig. 85) 3 mill. in diam., width of the calcified part of the large whorl 0·8 mill. It has only a quite small and not projecting spire, which is prolonged in a pretty long continuation below, this being excavated on the anterior side. Spire and the wide simple whorl chalk-white and hard, the latter with thickened hind margin. This hard part of the shell is surrounded by a yellow cuticle, and this again by a quite thin colorless cuticle.

St. Thomas and Guadeloupe (Riise).

Doridium punctilucens Bergh, Mittheil. Zool. Stat. Neap., xi, p. 131, pl. 8, f. 16.

This species is quite distinct from those of the Mediterranean, and will be easy to recognize by its color (emerald-green spots of the back, the linear striation, especially beneath), and the form of the shell also differs.

A. gemmata Mörch. *Unfigured.*

Subcylindrical, narrower in front, yellow or dull fleshy with close longitudinal black lines. Shield dilated in front, with obscure, small close longitudinal lines, often bifid or forked, diverging, and beautiful green, shining, convex spots, of which there are four arranged bead-like on the neck, especially conspicuous. Mantle convex, with large obscure clouds and very close black lines. Anal and respiratory tubes entire and strong; below bilobed, left lobe falciform, right lobe tongue-shaped, subtruncate. Gill-plume acute and arcuate; foot lobed on each side, ornamented with black longitudinal lines often confluent; thence it is spotted, and reticulated in front; foot lobes narrow, margin arcuate, reflexed, blackish above with spots and dots of yellowish here and there confluent. Length 18, diam. 7, alt. 8 mill. Shell not seen, but by the feel it seems to be narrow falciform.

St. Thomas (Riise).

Doridium (*Posterobranchæa*) *gemmatum* Morch, Journal de Conchyl., 1863, p. 25; Mal. Bl., xxii, p. 175.

Genus (?) Philinopsis Pease, 1860.

Philinopsis Pse., P. Z. S., 1860, p. 21.

Animal.—Head-disk large, oblong, oval or triangular, not extending in advance of the foot. Posterior to the head-disk the body is extended in the shape of a convex fleshy lobe, commencing under the head disk (which overlaps it), and reaching to or slightly beyond the posterior portion of the foot; truncated behind, and the truncation surrounded by an undulated or crenated crest. Eyes not visible. Mouth proboscidiform between cephalic disk and foot, with or without one pair of tentacles on sides of the mouth. Foot large, rounded and reflected at the sides. Branchial plume near the posterior end of the body, and curving around between the truncated end of the foot. Shell concealed in the truncated end. (*Pse.*).

My knowledge of this group is limited to Pease's descriptions here reprinted in full. I am disposed to consider it synonymous with *Aglaja*.

P. speciosa Pease. *Unfigured.*

Oblong, smooth. Head-disk about half the length of the animal, of an oblong, triangular shape, truncated in front, and corners obtusely rounded. The mantle lobe is convex, rather narrowed anteriorly and truncated posteriorly, commencing under the head-disk and extending slightly beyond the posterior portion of the foot; the truncated end is prolonged behind laterally, and surrounded by an elevated undulated crest. No visible eyes or dorsal tentacles. Oral tentacles small, dilated, truncated, and placed at the sides of the mouth. The foot and the head-disk project in advance of the mouth, which can be protruded in the shape of a proboscis. Foot broad, oval, smooth, rounded and reflected at the sides. Branchial plume single, pinnate, arising from the right posterior end of the animal, and curving to the left between the foot and the truncated end of the mantle-lobe. Excretory orifice posterior. Shell concealed in the truncated end, white, thin, fragile, pellucid, subtriangular, with a curved callous apex; surface with furrows of growth. Color above fawn, spotted and speckled with white; margins more or less varied with blackish and yellow; sides paler. Foot purplish fawn, and closely freckled with whitish, and broadly margined on

both sides with the dorsal colors intermixed. Length, 3 inches. (*Pse.*).

Station, among sea-weed on the coral reefs. They were very sluggish in confinement. One specimen, when placed in a glass jar, voided about a dozen small Bullæ shells perfect. They differ but a trifle in color, some being darker than others. The foot always remains turned over on the sides of the body. (*Pse.*).

Sandwich Is., among sea-weed on the coral reefs (Pse.).

Philinopsis speciosa Pse., P. Z. S., 1860, p. 21.

P. nigra Pease. *Unfigured.*

Oblong, slightly rugose above. Head-disk rather more than one-third of the length of the animal, oblong oval, acutely rounded in front and rounded posteriorly. The mantle lobe rather wider than head disk, of an oblong-oval shape, and the lateral ends of the truncation prolonged posteriorly into compressed crenate lobes, which are continued over the truncated portion, forming a slight crest. No visible eyes or tentacles. Shell buried in the truncated end. Foot elliptically oval, smooth, revolute laterally. Branchial plume single, situated on the right posterior end, and curving to the left. Color black, with two large white spots on anterior end, also two on the head-disk and two on the mantle lobe; sides white, and foot white, with three large black spots on each revolute side. (*Pse.*).

Sandwich Is., on sea-weed in upper laminarian zone (Pse.).

Philinopsis nigra Pse., P. Z. S., 1860, p. 22.

Genus NAVANAX Pilsbry, 1895.

Strategus Cooper, Proc. Cal. Acad. Sci., ii, p. 202, (1862). Not *Strategus* Hope, 1837 (Coleoptera).—*Navarchus* Cooper, Proc. Cal. Acad., iii, p. 58, (1863). Not *Navarchus* de Fil. et Ver., 1857, (Pisces).—*Navarchus* Bergh, Mitth. Zool. Stat. Neap., 1893, p. 133; Bull. Mus. Comp. Zool., xxv, p. 213.—*Navanax* Pils., Nautilus, viii, p. 131 (March 1, 1895).

Body elongated, similar in general characters to *Aglaja*, but anterior angles of head-shield produced to form short involute rhinophores. Shell as in *Aglaja*. Type *N. inermis* Coop.

Two species of this genus are known, both from west America.

N. INERMIS Cooper. Pl. 15, figs. 89, 90, 91, 92, 93.

Back of the body, foot and outside of pleuropodia wine-purple, ornamented with rounded or oblong spots of yellow; inner sides of pleuropodia flesh colored. Free edges of pleuropodial lobes and inner edges of the tail lobes and rhinophores orange colored with adjacent band and alternating spots of blue; lower side of tail-lobes purple-blue; eye-patches white with black centers. Length 3½, breadth of body proper ¾ inch (living animal).

Shell quite thin and completely flexible, brownish-yellow, without trace of calcification. As near as could be ascertained its form is as in *N. œnigmaticus* and *Aglaja depicta*. Its position is as in *Aglaja*. Penis (pl. 15, f. 89) similar to that of the *Aglajas* in general characters.

San Diego Bay (Cooper); *Catalina Island* (Cooper, Dall).

Strategus inermis COOPER, Proc. Cal. Acad., ii, p. 202.—*Navarchus inermis* COOPER, Proc. Cal. Acad., iii, p. 58.—BERGH, Bull. Mus. Comp. Zool., xxv, p. 214, pl. 10, f. 13; pl. 11, f. 2–5.

The alcoholic specimen examined by Bergh was light coffee-brown above with many yellowish-white lines, streaks and spots, the sole black with a slight brown tinge, spotted throughout with large, small and minute rounded yellow spots, coalescing on the median line to form a band.

N. ÆNIGMATICUS Bergh. Pl. 14, figs. 79, 80; pl. 15, figs. 86, 87, 88; pl. 6, fig. 39.

Length 25, alt. 10, breadth 10 mill. Color dirty light yellowish-white, strongly and irregularly marbled and dotted with black and gray, most so on sole. Outer half of inner side of pleuropodia uniform white the entire length; inner half brown-gray. Outer edge with numerous black flecks; gill yellow. Form perhaps narrower than in the true Doridiums. The projecting, slightly concave anterior border of head is produced on each side in a tentacular hook below the rhinophores (pl. 15, f. 87). Rhinophores rolled as in *Pleurobranchus*. Posterior shield a little longer than the anterior, its front edge but little raised. The hind edge of the shield seems to have a narrow free edge projecting above the tails (pl. 6, fig. 39, dorsal view of animal); but this may be a result of contraction. The tail-wings are somewhat as in *Aglaja depicta*, united above, separated below.

Shell (pl. 14, figs. 79, 80) situated in the posterior part of hinder-body at the base of the tails, consisting of a chalky, white portion and a thin cuticular part double the width of the former. Penis as usual, the prostate gland T-shaped, granulose (pl. 15, fig. 86).

Bay of Panama.

Navarchus œnigmaticus Bergh, Bull. Mus. Comp. Zool., xxv, p. 217, pl. 10, f. 11, 12; pl. 11, f. 6–9; pl. 12, f. 8–10.

II. Tectibranchiata Anaspidea.

Tectibranchs without a fleshy head shield, the head bearing two or four folded or slit tentacles; shell spiral or plate-like, usually enclosed by the mantle, with posterior terminal nucleus; rarely absent; pleuropodial lobes developed. Penis near the right anterior tentacle, widely separated from the female orifice and vas deferens, which open near the gill.

Two distantly related families compose this division:

Aplysiidæ with plate-like shell largely or wholly buried, or none; a conspicuous furrow connecting the furrowed penis with the common genital orifice; the radula multiserial.

Oxynoeidæ with the shell spirally convoluted, *Bulla*-like, not buried; no furrow between genital apertures, and, as far as known, a uniserial radula.

Family *APLYSIIDÆ.*

Animal lengthened, not protected by a shell, the neck and head narrower than body, mouth a vertical fissure; anterior angles of head produced in two tentacular lobes folded above; behind them the cylindric or conical rhinophores slit above, in front of which are the minute eyes. Epipodia or pleuropodia recurved over the back, forming two lateral or dorsal lobes enclosing mantle and gill. Genital orifice within the dorsal slit, communicating by a long furrow with the invertable penis which is near the anterior right tentacle. Shell nearly or entirely covered by the mantle, uncoiled, in the form of a concave plate, sometimes absent. Mouth with corneous jaws and a large multiserial radula composed of similar teeth; stomach armed with cartilaginous nodules; anus behind the gill.

Rather large animals of flabby consistency, remarkable for the four large ear-like tentacles and high back, which have earned for

them the name of Sea Hares. They are nearly world-wide in distribution in tropical and temperate seas, and almost without exception inhabit shallow water. Marine plants form their main food. Their colors in life are often bright and variegated, but in alcohol the green and violet tints are evanescent, fading usually to a dirty light olive; but the black pigment remains unchanged, so that markings of black or gray are premanent in specimens preserved in the ordinary manner.

Being without shelly armor, *Aplysiidæ* are largely dependent upon imitative coloring for protection; this being supplemented by the ability to expel a large amount of violet or purple fluid darkening the water around them, and also a milky fluid of nauseous odor.

Only one species has been known to be utilized by man: *Dolabella teremidi* being esteemed and largely used for food by the natives of Borabora.

The means of locomotion are varied: *Tethys* not only crawls, but swims actively by means of the muscular, wing-like pleuropodia, or "swimming lobes;" *Dolabella, Petalifera, Phyllaplysia* and other genera with largely united pleuropodia, are restricted to creeping like ordinary snails; *Notarchus*, which lives exclusively upon floating sea-weeds, has a narrow foot adapted to travelling along their slender stems, but has also been observed to dart rapidly by a forcible expulsion of water from the large gill cavity by contraction of its enclosing walls. This method, very exceptional in a gastropod, is quite analogous to that of the squids.

Notes on external and internal anatomy.

The notes following are mainly restricted to features useful for purposes of classification, the limits of this work denying space for any thorough discussion and illustration of the anatomy and histology of the group.

The main external features of *Aplysiidæ* are shown by the figures and diagrams on plates 35 and 66. The head and tentacles are sufficiently shown in pl. 35, fig. 31; to the right of the right rhinophore or posterior tentacle is seen an eye, and the *genital groove;* behind are seen the two *pleuropodia* or *swimming lobes*, one folded over the back, the other spread; within these is the oval *mantle*, the smooth inner portion of which encloses the shell, to which a median pore, the *mantle foramen*, opens; on the right is seen the free margin of mantle, which is fleshier, and contains along its inner

edge numerous glands secreting the purple fluid. Posteriorly the mantle spreads backward in a folded tongue or lobe, the *excurrent siphon*; at the base of this opens the anus, either as a pore or a short tube. Under the right side of mantle lies the *gill*, a single lunate plume. In pl. 35, fig. 32, the margin of the mantle is shown by the dotted line *m m*. Under its anterior right edge is seen the *genital orifice*, continued in the *genital groove, gr.*; behind this at *o* is seen the orifice of the *opaline gland*.

The Opaline Gland (variously known as the "grape bunch-shaped gland," "gland of Bohadsch," etc.) is a rather large body, sometimes consisting of numerous oval unicellular glands each with its independent efferent duct (pl. 33, fig. 25), but usually composed of a a grape bunch-like mass of cells communicating with a common cavity, opening externally by one orifice (pl. 33, fig. 24). Three sorts of cells compose it: odoriferous cells, color-secreting or purpurigene cells, and giant mucus cells; the first two present the same histological features, the protoplasm being granulose, the nuclei generally visible; in the mucus glands the protoplasm is homogenous, nucleus not always visible. The gland secretes three liquids: a white and odorous fluid which imparts to Aplysia its disgusting smell, a violet and a mucous substance. In some species the violet secretion is wanting. Morphologically the gland is similar to the purple-secreting glands of the mantle. It is ectodermal in origin, innervated from the pedal ganglion, and its special function is apparently the secretion of odorous fluid for defensive purposes. It seems to be special to the *Aplysiidæ*, and probably has no homologue in the *Cephalaspidea*.

The radula in Aplysiidæ is broad, somewhat lance-head shaped (pl. 33, fig. 23; pl. 9, fig. 13, 14), composed of many rows of numerous, nearly similar teeth with denticulate cusps, the rachidian tooth being wider, with bilobed spreading base.

In *Tethys* the teeth have long cusps, closely serrate on both outer and inner sides (pl. 9, figs. 11, 12, *T. punctata*).

In *Dolabella* the radula is extremely peculiar, the teeth being all unicuspid, very narrow, not serrate. See under sub-family *Dolabellinæ*.

In *Dolabrifera* the denticles on the cusps are few, laterals mostly tridenticulate, with no denticles on the inner margins of cusps.

In *Petalifera* the radula is considerably like that of *Dolabrifera* (pl. 55, fig. 12, *P. virescens*).

In *Phyllaplysia* the teeth are tricuspid, denticles broad and obtuse (pl. 9, fig. 26, *P. lafonti*).

In *Notarchus* the teeth are narrow with long cusps closely serrate or barbed on both inner and outer edges.

The buccal mass (pl. 62, fig. 4, *bm*) is large and muscular, two much lengthened salivary glands (*s. g.*) enter it, one on each side of the long œsophagus. The stomach (*s*) consists of three portions: an anterior thin-walled sack, a median hard and muscular belt armed inside with pyramidal cartilaginous nodules for triturating the food, and following this a thin-walled portion containing internally smaller nodules or spur-like appendages. This passes into the intestine (*i*), which is coiled about the large liver or digestive gland (*d. gl.*), the ducts of which, several in number, enter it near the point marked *x*. Becoming free from the liver, the intestine crosses the *ovo-testis* in a groove, and terminates externally at the base of the excurrent siphon (see pl. 62, fig. 4, *Aclesia pleii* Rang; pl. 9, fig. 15, *Tethys punctata;* pl. 40, fig. 2, *Notarchus punctatus* Phil.).

The genital system (pl. 62, figs. 1, 2, *Aclesia pleii* Rang) consists of a hermaphrodite gland or ovo-testis (*o. t.*) which communicates spermatozoa and ova by a common duct, the small hermaphrodite duct (*h. d.*), to the "annexed genital mass," G. In this mass the hermaphrodite duct splits (fig. 3, *div.*): by one branch (the Cuvierian duct, *Cuv.*), communicating with the spermatheca, *sp.*, the other branch, oviduct, involved in a complex series of convolutions partly concealed in the annexed mass (fig. 3, diagrammatic, showing convolutions of oviduct [*ov.*], Cuvierian duct [*Cuv.*] and spermatheca [*sp*]). The middle of the annexed genital mass is composed of the albumen gland (*alb.*), visible only on the lower surface of the mass. At the base of this mass is the spermatheca, *sp.;* downward is the greater hermaphrodite passage (*ghd*), bearing below the globular Swammerdam's vesicle (*S. v.*), which is functional as a reservoir of spermatozoa; and the female system ends below this in the external opening (*o*). Thence the male system continues as a groove or furrow in the integument passing forward to the vicinity of the right anterior tentacle, where the penis is situated. This organ (seen retracted in pl. 62, fig. 2, and extended in pl. 37, fig. 19) is grooved lengthwise, continuing the furrow just described, for the passage of spermatozoa. It is retracted by a muscle attached distally to the body wall (fig. 2, *rm.*).

Pl. 62, figs. 1, 2, represent *Aclesia pleii;* fig. 3, is a diagrammatic figure representing the internal structure of the annexed genital mass of *Aplysia.*

Literature of the Aplysiidæ.

(I) After the early work of BOHADSCH on the anatomy, and LINNE on the "system," of Aplysia, the group received little attention until (II) CUVIER published his *Memoire sur le genre Aplysia* in 1803. This was followed by an anatomical and systematic monograph of the Mediterranean forms by DELLE CHIAJE (1823), and an illustrated monograph by BLAINVILLE in Journal de Physique, etc., Vol. 96, 1823. This monograph is the only systematic work on the group which the writer has not seen. Its substance seems to be repeated by Blainville in his articles, "*Lièvre marin*" and "*Dolabelle,*" in the Dictionnaire des Sciences Naturelles, 1819, 1823. See also his Manuel de Malacologie, 1825.

The next stage (III) in the history of the group is represented by RANG'S monographic Histoire Naturelle des Aplysiens, 1825; one of the most satisfactory monographs ever written on a mollusk group, and, although now nearly seventy years old, still singularly useful and complete. Scarcely any descriptions of species by more recent writers approach those of Rang in lucidity and comprehensiveness. All of the main genera were understood by Rang, although he considered them subdivisions only of *Aplysia,* using that generic term in a rather wider than Lamarckian sense. Subsequent systematic work on the family has added little to Rang's foundation aside from new species. The genera *Aplysia, Dolabella* and *Dolabrifera* have been monographed by SOWERBY in the Conchologia Iconica, but as the plan of that work excluded all but purely *shell* features, these treatises are practically useless in the study of the *Aplysiidæ,* the shells of which are comparatively uncharacteristic.

(IV) In quite recent times the *Aplysiidæ* have attracted the attention of numerous morphologico-systematic zoologists, among whom may be mentioned BLOCHMANN, Mittheil. Zool. Sta. Neapel, 1884; VAYSSIERE, Recherches sur les Mollusques Opistobranches, 1885, MAZZARELLI, Atti della R. Accademia Scienze, etc., Napoli, 1890, 1891; Zool. Anz., 1889, etc.; ZUCCARDI, Boll. Soc. Nat. Napoli, 1890, and others. Nearly all of these investigations have been made on Mediterranean forms.

The *Aplysiidæ*, as a whole, are among the most modified Tectibranchs. None of the existing genera approach the primitive condition of the family. No fossil forms are known.

Analytical Key to Genera of Aplysiidæ.

a. Anterior ends of pleuropodial (dorsal) lobes well separated, the lobes mobile and freely separable, at least in front; shell thin, with but little lime; genital orifice in front of the gill. External integument not warty. Lateral teeth with long cusps, serrate on both sides, *Aplysiinæ*.

b. Rhinophores (posterior tentacles) situated near the middle of the space from anterior ends of dorsal lobes to the front tentacles; genital orifice under edge of mantle, I. Tethys.

bb. Rhinophores small, situated between anterior ends of dorsal lobes; mantle posterior, the genital orifice in front of and not covered by it, II. Paraplysia.

aa. Anterior ends of pleuropodial lobes contiguous, separated only by the genital groove, the lobes not freely mobile or readily spread outward; external integument usually warty or roughened.

b. Genital opening well in front of the main mass of the gill; radula with a wide central tooth, and narrower laterals with several denticles, *Dolabriferinæ*.

c. Mantle covering gill, at least in part; dorsal slit mainly or wholly behind middle of the animal's length; sole of foot broad.

d. A small but well-developed shell present; back of animal convex.

e. Body widest behind middle; no opening in the mantle exposing the shell; gill largely uncovered by, and projecting beyond, the mantle, III. Dolabrifera.

ee. Body widest near the middle; a large opening in mantle exposing part of the shell, IV. Petalifera.

dd. Shell wanting; body very flat; teeth tricuspid, blunt, V. Phyllaplysia.

cc. Gill not in the least covered by mantle; dorsal slit subcentral; sole narrower than the body; shell a minute vestige or absent; body plump, VI. Notarchus.

bb. Genital opening under the hind part of the gill; shell mainly calcareous, with deeply cut, curved posterior sinus, and subspiral, calloused spire; radula without central tooth, the teeth all narrow, of the same form, and with long, simple cusps, *Dolabellinæ*. VII. DOLABELLA.

Subfamily APLYSIINÆ Pilsbry.

Pleuropodial lobes well-developed, their anterior ends separated; genital orifice in front of the gill; radula with wide, denticulate rhachidian teeth, and narrower, serrate and denticulate laterals. Shell flexible.

Genus TETHYS Linné, 1758.

Tethys LINN., Syst. Nat. (10), p. 653, types *limacina* (unidentifyable) and *leporina* (1758).—PILSBRY, Proc. Acad. Nat. Sci. Phila., 1895, p. 347. NOT *Tethys* Linn., 1767, nor *Tethys, Tethis, Thethys, Thetis,* etc., of subsequent authors, to the present day.—*Aplysia* LINN., Syst. Nat. (12), p. 1072, and of most subsequent and all modern authors.—*Laplysia* LINN., *tom. cit.*, p. 1082, type *depilans*.—*Siphonotus* A. ADAMS & REEVE, Zool. Samarang, Moll., p. 64 (1848), type *S. geographicus* (preoccupied).—*Syphonota* PEASE, P. Z. S., 1860, p. 23.—*Syphonopyge* BRONN, Klassen und Ordnungen des Thier-Reichs, iii, Malacozoa, pt. 2, p. 799 (1866), type *S. geographicus*.—*Neaplysia* COOPER, Proc. Cal. Acad. Sci., iii, p. 57 (1863), *A. californica* Coop.—*Esmia* LEACH, Synopsis Moll. Gt. Brit., p. 33 (1852), type *E. griffithsiana* = young *Tethys punctata* Cuv.—*Lernea* BOHADSCH, 1761, (not binomial), and of Linnæus' 5th and 6th editions.—*Dolabella* RISSO, 1826, and in part of LAMARCK, 1822.

Animal swollen behind, narrower in front, with rather long neck and head, bearing folded tentacles and slit rhinophores as usual in the family, the latter about midway between tentacles and dorsal slit. Pleuropodia arising in front of the middle of animal's length, ample, freely mobile, free throughout their length or united for a distance behind, functional as swimming lobes; anterior ends separated. Mantle nearly covering the gill, having a median tube, foramen or orifice communicating with shell-cavity, and produced behind in a more or less developed lobe or lobes, folded to form an excurrent siphon. Genital orifice under front edge of mantle, in front of gill; opaline gland present, a short distance behind genital opening. Foot well-developed.

Shell very thin, membranous with a thin calcareous inner layer, nearly as large as mantle, concave, with pointed, small apex, bearing a recurved lamina, and having a concave posterior sinus.

Distribution: all tropical and warm temperate seas.

A reference to the table of genera on p. 64, will show the general relations this genus bears toward other genera of the family.

Species of *Tethys* have been known and noticed in the literature of the precocious Mediterranean peoples from very early times. The resemblance to a land mammal commemorated in the English common name, Sea-Hare, was first noticed by the Greeks, who called it *Lagoös thalassios*. The Romans and mediæval writers paraphrased this in *Lepus marinus;* and the French vernacular *Lièvre de mer*, the Italian *Lepre marina*, etc., retain the same idea. Some other French names for the slabby beast, more appropriate than polite, are given by Rang. The natural history compilers of the Roman and Middle Age periods, collected all sorts of absurd popular stories about the dangerous and deadly qualities of Aplysia; for the water-side folk the world over usually consider any uneatable animal as dangerous or poisonous. The memory of one of these tales—that baldness resulted from handling the animal—survives in the name of one of the species, *depilans*. The nauseous odor of the living animal may have something to do with its ill repute.

Aplysias not only crawl with facility, but the typical species swim freely and rapidly by means of a wing-like motion of the pleuropodia or "swimming lobes."

The generic name of the genus has been discussed by the writer in Proc. Acad. Nat. Sci. Phila., 1895, pp. 347–350; but a brief restatement of the facts there brought forward may be useful in this place.

The genus *Tethys* was founded by Linné in the tenth edition of the Systema Naturæ, p. 653 (1858), for two species, both of which are unquestionably sea-hares.

In the twelfth edition (1767) of the Systema, p. 1089, Linné wholly alters the diagnosis of *Tethys*, applying that generic name to the Nudibranch still known as *Tethys* (see Tryon, Structural and Systematic Conchology, ii, p. 381, pl. 90, f. 15; Fischer, Manuel, p. 533, pl. 13, f. 9; Woodward, Manual, pl. 13, f. 9). In this edition of the Systema, a new name, *Aplysia* or *Laplysia*, is proposed for the sea-hares. It would seem, therefore, that if we are to adopt the

tenth edition of the Systema, 1758, as the starting point for binomial nomenclature, no option is left us but to restore the earliest name, *Tethys*, to this group, and to reject that term from the nomenclature of nudibranchiata.

The features most depended on for specific characters are (1) the size and degree of union posteriorly of the swimming lobes; (2) the nature of the mantle-foramen leading to shell-cavity, which may be a large orifice, a minute puncture, or a little tube; (3) the degree of development of the free posterior lobes of mantle forming the excurrent siphon; (4) the nature of the opaline gland, grape-bunch-like or scattered, the former having a single external opening, the latter many; (5) the consistency and form of shell; and (6) color-pattern (rather than color), and general proportions of animal.

The structure of the penis will probably be utilized also, in future. The dentition presents slight differential characters, but too small to be of any practical value in discriminating species, so far as published figures and my own preparations go. Perhaps a wider range of observations will show greater divergence.

A large amount of work remains to be done before the internal classification of *Tethys* can be said to approach the standard of present-day zoology. So many species are still imperfectly known, or described merely from the least characteristic organ—the shell—that any attempt at a natural arrangement of the species now possible will doubtless be subject to much revision in the future. As a preliminary sketch is offered the following:

Synopsis of Subgenera and Sections.

Subgenus TETHYS Linné.

Body not prolonged backward in an attenuated tail; sole of foot wide.

Section *Tethys* (restricted).

Swimming lobes ample and free behind as far as their junction with the foot; opaline gland of the "grape-bunch" type, opening externally by a single orifice; mantle having a subcentral minute foramen or a little tube communicating with shell cavity; shell with no accessory plate arising within the upper margin. Type *T. leporina* Linn.

Section *Neaplysia* Cooper, 1863.

Swimming lobes short, somewhat united behind; opaline gland opening externally by a single orifice; mantle having a minute subcentral tube communicating with shell cavity; shell having a membranous erect accessory plate arising near the apex. Type and only species, *T. californica* Coop.

Section *Aplysia* Linné, 1766.

Swimming lobes ample, united behind the excurrent siphon; opaline gland multiple, opening externally by numerous independent ducts; mantle having a rather large oval thin-edged opening into shell cavity; shell with no accessory plate, usually convex and calcareous. Type, *T. depilans* Linné.

Subgenus Phycophila Adams, 1861.

Body compressed with long tail and narrow sole. Type, *T. euchlora* Ad.

In the following pages the species are arranged geographically, this being, perhaps, the best plan for the present, many forms being still known by the shell alone, and the characters necessary for the natural classification of some others are still unknown.

The section *Neaplysia* consists of but one known species, *N. californica*, p. 89.

Section *Aplysia* is widely distributed, and contains the following species:

European Seas: *punctata, depilans.*

West Atlantic and Antillean: *parvula.*

West America: *rangiana, (? nigra, ? inca).*

Polynesia: *elongata.*

Australian Seas: *concava?*

China and Japan: *fusca.*

Western Indian Ocean: *nigrocincta.*

Habitat unknown. *anguilla?*

Section *Tethys* is the most numerous in species, and occurs on all tropical and warm temperate coasts except western North America. All species not enumerated above are supposed to belong to this group; and probably *nigra* and *inca* of Orbigny also group here, although they have the swimming lobes united behind as in the restricted section *Aplysia.*

I. *Species of European Seas.*

a. Swimming lobes united behind as far up as the excurrent siphon ; mantle having a wide median orifice exposing the shell, its edges not thickened. A group of unicellular glands each with independent duct in place of the opaline gland *depilans, punctata.*

aa. Swimming lobes free to their union with the foot behind ; mantle having a median minute perforation or a little tube.

b. Opaline gland with multiple ducts ; green ; length 27 cm. *lobiancoi*

bb. Opaline gland grape-bunch like, with one duct.

c. Length 12–20 cm. ; very dark, sometimes flecked with light *leporina*

cc. Length 6 cm. ; obscure green, marbled with black *marmorata*

ccc. Pale yellowish with scattered black rings *dactylomela*

T. DEPILANS Linné. Pl. 23, figs. 26, 27 ; pl. 24 ; pl. 33, fig. 25.

Length about 20 cm. Shorter and more compressed than *T. leporina. Swimming lobes united behind as far forward as the mantle siphon;* foot rounded posteriorly. Mantle or gill-cover with *a broad round orifice leading into the shell-cavity, and surrounded by dark brown rays.* On the under side of mantle edge the numerous glands secreting a milky fluid (homologous with the purple glands of *T. leporina*) open. Siphon of the mantle shorter than in *leporina;* genital and anal openings as in *leporina.* Behind the genital opening there are numerous one-celled glands each with its separate opening, in place of the grape-bunch like gland of *leporina* (pl. 33, fig. 25).

Color extremely variable ; generally the ground is light brown, often gray-brown, rarely quite dark, always with white or light gray spots with irregular outlines. Shell similar to that of *leporina*, but with stronger calcareous layer.

Mediterranean and Adriatic Seas; Atlantic: Torbay, S. coast Devon, England, and Channel Is.; W. coast of France, Madeira, (? and Cape of Good Hope).

Laplysia depilans L., Syst. Nat., 12, p. 1082, founded mainly on *Lernea* of Bohadsch, de quibusdam animalius marinis, etc., pl. 1–3. —BARBUT, The Gen. Vermium, p. 31, pl. 3, f. 5, 6.—BRUG., Encycl. Méth., pl. 83, 84 (copied from Bohadsch).—LAM., An. s. Vert., PEN-

NANT, B. Zool., iv, p. 35, pl. 21, f. 21.—*Aplysia depilans* GMEL., Syst. p. 3103.—RANG, Hist. Nat. Aplys, p. 62, pl. 16, 17.—VAYSSIERE, Rech. Moll. Opistobr., p. 65, f. 51–58 (anatomy).—BLOCHMANN, Mittheil. Zool. Stat. Neapel, v, p. 32, pl. 3, f. 2, 5, 10 (anat.).—ZUCCARDI, Boll. Soc. Nat. in Napoli, (1), iv, p. 6, pl. 1, f. 1, 4, 10, 13, 15 ; pl. 2, f. 25–29 (teeth and jaws).—WATSON, Challenger Gastrop., p. 673.—MONTS., J. de Conchyl., 1877, p. 46.—*Tethys limacina* LINNE, Syst. Nat., 10, p. 653, *teste* Linné, S. N., 12, p. 1082.—? *Dolabella fragilis* LAM., An. s. Vert., vi, 2me pt., p. 42 (1822).—? *Aplysia "major"* LANKESTER, Philos. Trans., clxv, 1875, p. 13 (embryology).—*A. petersoni* SOWB., Genera of Shells, *Aplysia*, fig. 1.—? *Dolabella lavis* BLAINV., Dict. Sc. Nat., xiii, p. 395.—*Aplisia leporina* DELLE CHIAJE, Memorie, pp. 28, 41, 71, pl. 2, 4, 5 (1823).—*Aplisia poliana* DELLE CHIAJE, *t. c.*, p. 30, 73, pl. 3, f. 1.—*A. poli* DELLE CHIAJE, *t. c.*, p. 72.—*A. vulgaris* BLAINV., Man. de Malacol., p. 472, referring to Journ. de Phys., Vol. 96, fig. 8 (1825).

The large orifice in the mantle over the shell, surrounded by brown rays, and the posteriorly united swimming lobes are characteristic.

T. PUNCTATA Cuvier. Plate 30, figs. 1 to 11.

Length 7–15 cm. but mostly smaller ; form about as in *T. depilans*. *Swimming lobes completely united behind as far forward as the excurrent siphon*, not very ample. Upper surface of mantle iridescent, with a large, oval orifice leading into shell-cavity ; edge with purple glands as in *T. leporina*, and unicellular glands with granular contents, probably slime glands. Behind the genital opening is a group of one-celled glands as in *T. depilans*.

Color purplish-black, brownish or greenish-brown, always closely spotted with pale rounded dots and small spots, which usually show some opaque white specks.

Alcoholic specimens (well preserved) are gray (produced by minute ashy speckling on a clear ground) with pale spots, the lobes darker, their inside edges with alternating dark and light bars, mantle brown. Occasionally all pigment is lost.

Shell quite convex, pale yellow outside, ovate, the outer margin hardly angular ; beak well incurved ; calcareous layer nearly coextensive with the membranous, and moderately strong.

Mediterranean and Adriatic Seas ; Atlantic from Norway and all British coasts, to the Canaries.

Laplysia punctata Cuvier, Ann. du Mus., ii, p. 295, pl. 1, f. 2–4 (1803); Regne Anim., ii, p. 398.—Rang, Hist. Nat. Aplys., p. 65, pl. 18, f. 2–4.—Phil., Enum. Moll. Sicil., p. 124; ii, p. 97, pl. 22, f. 1.—Jeffreys, Brit. Conch., v, p. 5, pl. 1, f. 1.—Sars, Moll. Reg. Arct. Norv., pl. xii, f. 18 (anatomy).—Vayssiere, Rech. Moll. Opistobr., p. 68, f. 67–69 (anatomy).—Sowb., Conch. Icon., f. 41 *a*, *b* (shell).—Blochmann, Mittheil. Z. Stat. Neap., v, p. 34, pl. 3, f. 3, 6, 11, 13.—Zuccardi, Boll. Soc. Nat. Nap. (1), iv, p. 5, pl. 1, f. 3, 6, 9, 12, 16, 30–33 (jaws and teeth).—McIntosh, The Marine Invert. and Fishes of St. Andrews, p. 84, pl. 3, f. 1.—*A. hybrida* Sowb., Brit. Misc., pl. 53 (1806).—Forbes & Hanley, Hist. Br. Moll., iii, p. 544, pl. 114F, f. 4, and YY, f. 1.—*L. depilans* Penn., Brit. Zool., edit. 4, Vol. iv, p. 42, pl. 21, f. 21.—*A. varians* Leach, Syn. Moll. Gt. Brit., p. 33 (1852).—*? Esmia griffithsiana* Leach, *t. c.*, p. 34, pl. 7, f. 8–10 (young)=*griffithsiæ* Gray, Figs. Moll. Anim. iii, pl. 268, f. 13.—*A. mustelina* Davies, in Penn. Brit. Zool. edit., 1812, iv, p. 79, pl. 22.—*A. nexa* Thompson, Ann. Nat., Hist., xv, p. 313, pl. 19, f. 8 (1845).—*Aplisia cuvieri* and *A. cuvieriana* Delle Chiaje, Memorie, p. 41, 71 (1823).—*A. guttata* Sars, Archiv für Naturg., 1840, p. 213, pl. 7, f. a–g (embryology).—*? A. dumortieri* Cantraine, Malac. Médit. et Lit., p. 71, pl. 3, f. 2 (very young).—*A. subquadrata* "Gould," Sowb., Conch. Icon., xvii, pl. 9, f. 39*a*, *b*. *Conf.* Amer. Journ. Conch., v, p. 222.—*Aplysia punctata=cuvieri* Delle Chiaje, Mem. An. s. Vert. de Regno di Napoli, pl. 77, f. 15, 16.—*A. marginata* Phil., Enum. Moll. Sicil., ii, p. 98, pl. 22, f. 2.—*? A. marginata* Blainv., Journ. de Phys., Vol. 96, 1823, p. 285, f. 5; Dict. Sc. Nat., xxvi, p. 326; (described from specimens of unknown origin, in coll. of the College of Surgeons, London).—*Aphysia albo-punctata* Desh., Traité Elém. de Conch., ii, p. 59 (name only) pl. 92, figs. 1, 2 (1839–1857, Atlas, 1864).—*A. cuvieri* Delle Chiaje, Fischer, Faune Conch. mar. Gironde 2e Suppl., in Actes Soc. Linn. Bord., xxix, 1874, p. 193.—Monts., J. de Conchyl., 1877, p. 46.—*A. longicornis* Rang, Hist. Nat. Aplys., p. 66, pl. 19, f. 1–4 (1828).—*Aplysia stellata* Risso, Hist. Nat. Eur. Mérid., p. 43; Journ. de Physique, de Chimie et d'Hist. Nat. lxxxvii, p. 375 (1818).—*? Aplysia rosea* Rathke, Skrivter af Naturhistorie-Selskabet, v, 1ste Hefte, p. 85, 147, pl. 3, f. 12 *a*, *b* (1799).

This is smaller than the preceding species, with the lobes more united posteriorly, the orifice over the shell larger (its edge very

finely radially crenulate), and the system of coloring different. It is also more widely diffused.

The name *A. rosea* of Rathke, if really belonging to this species, has precedence over *punctata;* but it was founded on a young specimen, and the coloring described ("roseate, spotted with white and brown") is unlike any specimens known to me. It was from near Christiania.

Jeffreys (Brit. Conch., v, p. 7) refers the *A. varians* and *Esmia griffithsiana* of Leach to *punctata*. The descriptions and figures of these are very ambiguous.

T. LEPORINA Linné. Pl. 33, fig. 20, 21, 22, 23, 24.

Length of adults about 12–30 cm. Form when resting, comparatively high and narrow. Epipodial lobes large, completely free to the hind part of the foot. Foward tentacles are mere flat prolongations of the integument on each side of the mouth. The small eyes are forward from the bases of the true tentacles. Foot rather acute posteriorly; mantle or gill-cover with a foramen produced in a small tube in the middle above; the unicellular purple glands opening on the under side of its edge. Posteriorly the mantle edge forms a short siphon, in the depth of which lies the anus. Genital opening under the front end of the gill. Behind the genital opening is the orifice of the grape-like opaline gland (fig. 24). The albumen gland is orange-red.

Color deep velvety blackish-violet, frequently with gray or with whitish flecks. Tentacles and edges of epipodial lobes often with a more or less intense red border. Sole and inside of lobes lighter.

Radula with the formula 30·1·30 to 50·1·50 when adult, 70–80 transverse rows (pl. 33, fig. 23).

Shell 70 mill. long, 60 broad, 20 high, subquadrangular, convex, thin, subopaque, composed of two layers: the external layer is corneous, pale amber-yellow, membranous, and readily separated from the calcareous, vitreous lighter and shining inner layer. Surface with growth lines and obsolete radial folds and grooves. Spire covered by an irregular callous deposit.

Western basin of the Mediterranean; abundant on the coasts of Italy (Naples, etc.), Sicily, Algiers, southern coast of France (Gulf of Marseilles, etc.).

Tethys leporina LINNE, Syst. Nat., 10, p. 563 (founded on *Lepus marinus* of Rondelet, Lib. de Pisc. marinis, p. 520, woodcut).—

Laplisia fasciata Bosc, Hist. Nat. des Vers, i, 1802, p. 63.—*Laplysia fasciata* Poiret, Voy. en Barbarie, ii, p. 2 ; and in German translation of same, Reise in die Barbarey, 2ter Theil, p. 67 (1789).—Gmel., Syst. Nat., 13, p. 3103.—Cuvier, Ann. du Mus., iii, p. 295, pl. 2–4 (anatomy).—Rang, Hist. Nat. Aplys., p. 54, pl. 6, 7.—Vayssiere, Rech. Moll. Opistobr., p. 60, figs. 59–66 (anatomy).—Buq., Dautz, & Dollf., Moll. Rouss., i, p. 546, pl. 65, f. 4, 5 (shell).—Monts., Journ. de Conchyl., 1877, p. 45, and of authors generally.—*A. depilans* Blainv., Journ. de Phys., Vol. 96, p. 285 (1823), and Dict. Sc. Nat., xxvi, p. 327 ; Man. de Malacol., pl. 43, f. 4.—? *Dolabella lepus* Risso, Hist. Nat. Eur. Mérid., iv, p. 44, pl. 1, f. 1, 2 (1826).—*Aplysia lepus* Phil. (de novo), Enum. Moll. Sicil., ii, p. 99 (1844).—*Aplisia neapolitana* and *napolitana* Delle Chiaje, Mem. su la storia e Notomia delgi Anim. s. Vert. del Reg. di Napoli, i, pp. 31, 39, 70, etc., pl. 3, f. 2 (1823).—*A. camelus* Cuvier, Ann. du Mus. d'Hist. Nat., ii, p. 295, pl. 1, f. 1 (1803),=*A. cameliformis* Locard, Annales de la Soc. d'Agricult., etc. de Lyon, fifth ser., viii, p. 66 (1886).—*A. alba* Cuv., l. c., pl. 1, f. 5, 6 (both founded on alcoholic and decolored specimens).—*A. limacina* L., Blochmann, Mittheil. Z. Stat. Neapel, v, p. 29, pl. 3, f. 1, 4, 9, 12.—Zuccardi, Boll. della Soc. di Naturalisti in Napoli, iv, p. 5, pl. 1, f. 2, 5, 7, 8, 11, 14 ; pl. 2, f. 17–24, 34–37 (1890). Probably not *Tethys limacina* Linné, an *absolutely unidentifiable* species subsequently referred to *A. depilans* by Linn.—*Aplysia radiata* Crouch, Illustr. Introd. Lam. Conch., p. 44, pl. 14, f. 10, 10a (1827).

This is an abundant species, differing from *depilans* and *punctata* in the free backward extension of the dorsal lobes, and the minute foramen in the mantle leading to the shell-cavity, with the edges thickened, somewhat tubular.

I have not seen the original edition of Poiret's travels in which *A. fasciata* was first published, and therefore do not know its date. It was apparently after 1786, the last year of the voyage, and before 1788, because Gmelin cites it in the Systema. The German translation is 1789. I adopt Linnæus' specific name because Rondelet's figure and description of the coloration agree well with this species, and not with any other European Sea Hare.

T. lobiancoi Mazzarelli. *Unfigured.*

Length (in alcohol) 27 cm. Green. Swimming-lobes *free as far as their union with the foot behind,* as in *leporina.* Gill-cover

ample, and *its opening is very small.* Siphon as in *leporina*, long; and over its inner right wall lies a very large anal opening. Gill as figured by Blochmann for *depilans.* Genital opening lies under the gill-cover a little in front of the gill, as in other Aplysias. Sperm-groove ends a little before the right tentacle, as in *leporina* and *chierchiana.* The tentacles show nothing characteristic. The radula is lancet-shaped, with 37 rows, the median ones with 41·1·41 teeth. Penis similar in shape to that of *depilans*, but it is not black (in alcohol), and its sheath does not show the papillæ as in *depilans.* The opaline-gland (or gland behind the genital opening) consists of *a group of one-celled glands, each with its separate efferent duct*, as in *depilans*, *lessoni* and *punctata.*

Shell 75 mill. long, very thin, entirely transparent and almost without chalky layer. In general it agrees nearly with that of *leporina.*

Bay of Posilippo, Gulf of Naples (Lo Bianco).

Aplysia lobiancoi Maszarelli, Nachrichtsbl. D. Malak. Gesellsch. xxii, 1890, p. 42.

This species seems to have been described from one alcoholic specimen, scarcely to be distinguished from *leporina* in external anatomy, but with the opaline gland and penis more as in *depilans.* It can hardly be regarded as well founded until living specimens are described, and the anatomical features are found to be constant.

T. marmorata Blainville. Pl. 33, figs. 26, 27, 28, 29.

Length about 60 mill. Oval, smooth, the foot acute behind. Swimming-lobes large. Mantle broad with a median tube; the excurrent siphon conic and quite long. Color, obscure greenish, marbled with black spots.

Shell ovate, elongated, very concave, nearly membranaceous, or at least with a slight calcareous layer readily lost in alcohol; buff-livid; apex feebly curved toward the upper sinus of the shell, which is far back and little arcuate. Length 20 mill.

West coast of France; Bayonne, Rochelle, etc.

A. marmorata Blainv., Dict. Sc. Nat. xxvi, p. 326 (1823); Journ. de Phys., Vol. 96, p. 286, f. 3, 4.—Rang, Hist. Nat. Aplys., p. 58, pl. 12, f. 6–9.

I have not seen this species. It will probably group near *leporina.*

T. MELANOPUS Crouch. Pl. 38, figs. 1, 2.

This form is described as 4½ inches long, very plump, foot of a dark brown color; whole of the body with the exception of the mantle and foot, is marked with tints of red on the brilliant yellow surface. The shell is two inches wide, half-oval, thin, subcartilaginous and marked with faint lines diverging from the straight border; almost, but not exactly in the middle of the upper portion was a prominence or projection, but so injured as not to be accurately defined. Its surface was slightly tinged with brown.

East coast of Cornwall.

Aplysia melanopus CROUCH, P. Z. S., 1870, p. 173, figs. 1, 2.

Known to me by Crouch's description and figures. The structural characters are still unknown. Type is in British Museum.

II. *Species of the West Atlantic and Gulf of Mexico.*

a. Mantle with a minute median perforation or a little tube; opaline gland opening by a single orifice.
  b. Variegated with rings or ocellated spots.
    c. With scattered large black rings, *dactylomela, œquorea.*
    cc. With many small rings, *protea, schrammi.*
  bb. Maculated or clouded with blackish; shell with extremely thin calcareous layer, *livida, willcoxi, cailleti.*
  bbb. Uniform black outside, or nearly so.
    c. Mantle with a tube; swimming lobes arising far back unicolored, *braziliana.*
    cc. Mantle with perforation; lobes with spots along inner margin, *floridensis.*
aa. Mantle with a large median orifice.
  b. Animal small; shell very convex, calcareous, *parvula.*

T. DACTYLOMELA Rang. Pl. 32, figs. 16, 17, 18, 19.

Length about 17 cm. Always much swollen, with elongated head and tail; rugose. Mantle or *gill-cover with a minute central tube,* and a well developed siphon behind. Swimming lobes not united as far forward as the siphon.

Color pale yellow of various shades, more or less covered in different individuals, with *black rings,* irregular and of various sizes. *Inner sides of lobes and the mantle with large black spots* of different forms. Borders of the swimming lobes tinged with violet.

Shell large, much dilated, a little diaphanous, amber colored outside, with a visible enamel within; posterior sinus deeply arcuate; beak recurved, triangular, thick and calloused. Alt. 42 mill.

Strait of St. Iago, Cape Verde Is. (Rang); *Bermuda ?, Bahamas ? Florida ?*

Aplysia dactylomela Rang, Hist. Nat. Aplys., p. 56, pl. 9 (1828).—Rochebrune, Nouv. Arch. du Mus., 1881, p. 264.

A. ocellata Orb., Hist. Nat. des Iles Canaries Moll., p. 44, pl. 5, f. 1–4.

A. æquorea Heilprin, Proc. Acad. Nat. Sci., Phila., 1888, p. 325, pl. 16, f. 2; and The Bermuda Islands, p. 185, pl. 15, f. 2a, 2b (1889). *Conf.* Dobson, Journ. Linn. Soc., xv, p. 159.

Like *T. leporina*, this species has a minute, tubular foramen over the shell.

Several east and west Atlantic forms agreeing in the marking of dark rings and the minute, tubular orifice in the mantle, may best be included as varieties under *dactylomela* until they are shown to have differential features of value.

Var. ocellata Orbigny. Plate 31, figs. 12, 13, 14, 15.

Length 33 cm. Elongated, flabby, very fleshy, thick, enlarged behind; neck long; mouth encircled by rather wide lips and large, thick buccal appendages, depressed and convoluted at their ends; tentacles stout, short, conic; eyes small, placed in front of the tentacles. Swimming lobes large, equal, thick, united behind. Mantle large, *without orifice above*, ending posteriorly in a wide, thin tongue, sometimes greatly extended. Gills foliated in regular branches, which sometimes are extraordinary prolonged. Foot narrow, folded, strongly contracted at neck, and acuminate behind.

Colors: The sides, neck and head are marked by *ocellations of black-violet which surround a yellow spot subdivided by crack-like lines.* The intervals between ocellæ are yellow, subdivided in the same way with black-violet lines. On the head, in front of the tentacles, are two more regular ocelli. Tentacles and buccal appendages are zebra-striped with the same color on a yellowish ground, more or less violet tinged. Parts bordering the foot visibly violet. Inside of lobes clear violet, marked with indistinct longitudinal lines. *Mantle violet, with yellow spots divided by lines;* and there is one rounded black spot, surrounded by a marginal band of very deep violet. The gills are clear rose-violet. Foot rose color.

Shell of the usual form, very thin, and provided at the beak with *a strong raised plate above*, which is not found in European species.

Near Santa Cruz, Teneriffe, Canaries (Orb.).

Var. ÆQUOREA Heilprin. Pl. 35, figs. 33, 34, 35.

"Length about 4½ inches. Body broadly oval, with a moderately elongated neck; tentacles cylindrical, slit at the extremity; buccal lobes broad, infolded; *opercular cavity on a slightly raised papilla*" *Swimming lobes very ample, free, united behind only at their insertion far back on the foot*, which seems short posteriorly. Right edge of mantle deeply sinused at its posterior third, with a short excurrent siphon. Genital orifice slightly in front of, and below the anterior insertion of gill. Opal-gland with a single orifice about 6 mill. back of genital orifice.

Color (in alcohol) light olive-gray, with very sparsely scattered irregular and unequal rings, traced in narrow black lines, and ranging from 3 to 5 mill. diam. There are also a few irregular black lines. *Insides of swimming lobes and the mantle unicolored brownish-drab, free from markings*, except for a couple of small black blotches within left lobe.

Shell with a moderately strong layer of lime at the apex, thickened, calloused, *and reflexed backward in an erect plate* (somewhat like a *Pholas* valve); outer layer yellow, membranous; posterior sinus rather deeply concave, nearly half the shell's length, and forming an angle with the outer lip. Length about 42 mill.

Bermuda, in shallow water, south side of Castle Harbor, opposite Tucker's Town.

The above description is from the type collected by Professor Heilprin. It is considerably contracted and the shell has been removed. The original description was also from the alcoholic (not the living) animal, the length being supplied from memory. As Heilprin remarks, this form differs from *dactylomela* and *ocellata* in lacking the markings on the mantle and the insides of swimming lobes; moreover in this individual the black circles are very few in number and delicately outlined, and the swimming lobes are not violet bordered. As it was not described living, no complete comparison can be made with d'Orbigny's circumstantial account of *ocellata*. The identity of the Bermuda *Aplysia* commented upon by Dobson, that collected in the Bahamas by Dr. Dolley, and the *A. schrammii* of Deshayes, with the present form remains problematic

until series of specimens can be examined. Dobson's Bermuda specimen had the mantle much variegated. It is likely that the type of *æquorea* is young, hardly over half-grown.

T. PROTEA Rang. Pl. 37, figs. 20, 21, 22.

Length 16 cm. Body slabby, extremely swollen, the tentacles quite long. Smooth, of variable color, but green and yellow predominate, with numerous ring-shaped spots of black, red and green.

Shell wide, the apex much projecting and triangular. It is quite solid, the calcareous layer nacreous, sinus rather deep but quite wide. Cuticle yellow. Length 36 mill.

Bay of Fort Royal, Martinique (Richard, Plée).

A. protea RANG, Hist. Nat. des Aplysiens, p. 56, pl. 10, f. 1–3 (1828).—ORBIGNY, Moll. Cuba, i, p. 117.—MORCH, Malak. Bl. xxii, p. 176; Journ. de Conchyl. 1863, p. 23.—BEAU, Catal. Coq. recueillies à la Guadaloupe et ses dépendences, p. 20.—ARANGO, Fauna Malac. Cubana, p. 155.—[KREBS] The West Indian Marine Shells, p. 91.—DALL, Proc. U. S. Nat. Mus. vi, 1883, p. 324; Cat. Mar. Moll. S.-E. U. S. (Bull. U. S. Nat. Mus. No. 37) p. 90; List of Marine Mollusca, etc., p. 24, 25.

This species has been reported from Key West, Florida (Hemphill), St. Augustine, Fla. and Bermuda (Dall), Cuba (Arango), St. Thomas and Sta. Cruz (Riise, Krebs, Mörch *et al.*), Ilet à Cochons, near Guadaloupe (Beau), Carthagena, Columbia (Krebs); but some of these localities may rest upon incorrect identifications.

This beautiful species, very abundant in the Antilles, says Rang, is quite distinct from all its allies. The back is extremely swollen, the swimming lobes are large, with usually wavy borders, the neck is slender, and the tail pointed. The tentacles are large, the mantle flabby, foot large, and operculum much extended. The coloration is very changeable. In the water it appears greenish; and in the air has a different aspect. The general color is then yellowish, reflecting a golden tint; but under all circumstances there are a great number of black rings, varied with green and red. The colors, as well as the form and arrangement of these spots vary a good deal, but they have a handsome effect, especially when the animal is alive. The membrane of the opercle [mantle] as well as the inside of the swimming lobes are covered with large and irregular black spots. *When preserved,* the animal assumes a livid color, *but the black rings*

always are retained. The shell of *A. protea* is one of the most beautiful of the genus. Outside it is a beautiful straw-color, covered within by quite a thick calcareous layer, sometimes very nacreous. This animal is known to the negro fisherman by the name *baril de vin*, on account of the beautiful fluid it secretes.

The following seems to be a synonym:

A. schrammii Deshayes. Uniform yellowish-white, prettily ornamented over the whole surface of the body with small circles of black, unequal and very irregularly scattered (*Desh.*, Journ. de Conchyl. [2], ii, [1857], p. 140). Described from an alcoholic specimen; no information additional to the above has been published. It may prove to be a *T. protea* which has lost all coloration except the black circles by the action of alcohol.

Gaudeloupe (Schramm).

T. LIVIDA d'Orbigny. Pl. 20, figs. 37, 38, 39.

Length 13–16 cm. Elongated, quite elevated, flabby, wide in the middle, acuminate behind; neck long. Buccal appendages separated by a deep groove in front, very long, narrow, smooth. Tentacles short, subconic. Eyes black, in front of tentacles. Mouth with thin lips; foot narrow, plicate in front, lengthened behind. Swimming lobes wide and rounded, united behind. *Mantle without perforation above*, but having a depressed line. Siphon long, tongue-like; gill longer than mantle.

General color yellowish, mixed with green; upper parts spotted with light yellow. *Inner borders of swimming lobes with a series of equidistant, squarish, yellow spots.* Its fluid is pale rose colored; odor musky.

Shell depressed, very thin, oblong, the posterior sinus shallow; apex somewhat encrusted.

Bay of Rio Janeiro, Brazil (Orbigny, in October).

Aplysia livida ORBIGNY, Voy. dans l'Amér. Mérid., p. 206, referring to pl. 18, f. 3–5.—*Aplysia lurida* ORB., *t. c.* on pl. 18, f. 3–5.

Compare *T. willcoxi*, which seems to be nearly allied. I consider Sowerby's *A. guadaloupensis*, known only by a description and figure of the shell, as in all probability a synonym. The original description and figure are here reproduced:

A. guadaloupensis Sowerby. (Pl. 35, fig. 36). Shell talon-shaped, subcompressed, pale yellowish; radiately distantly lightly pitted, concentrically elegantly striped; within testaceous, pale pink. Apex

acuminated, produced, reflected, incurved; upper margin sloped, reflected, excavated, cuneate at the end; outer lip anteriorly sinuously produced; dorsal margin rather short, reflected; lower margin sloped obliquely towards the dorsal margin. (*Sowb.*).

Guadaloupe (Mus. Cuming).

A. guadaloupensis Sowb., C. Icon., pl. v, f. 19 (August, 1869).

"This shell is beautifully striped on the back." (Sowb.)

T. willcoxi Heilprin. Pl. 35, figs. 30, 31, 32.

Length about 11–15 cm. General form about as in *T. livida.* Anterior head-processes large, broad and prolonged downward, the reflexed portion erectly triangular, the mouth between their lower ends. Tentacles long, with a very short slit. Swimming lobes ample, united behind only where both join the foot. Mantle with a *very minute tubular perforation* with very short black rays around it, or in some specimens the perforation is not to be seen. Mantle edge posteriorly notched, and with a long tongue-like siphon lobe. Opaline gland long, opening by a single large orifice about 15 mill. behind genital orifice, the latter nearly as far forward as anterior edge of mantle.

Color in alcohol greenish-yellow, coarsely cloud-marbled or maculated on the swimming lobes, neck and head, with purplish-black; mantle light, with a dark cloud at the front edge. *Inside of the swimming lobes olive-blackish or purple-blackish* (rarely pale olive), *with a wide bordering series of irregular, rounded light spots at the edges.*

Penis conic, decidedly enlarged at base, and black-pigmented there; a long filament projecting from the apex.

Shell *very thin, flattened,* translucent; *inner layer extremely thin, a mere opalescent film;* outer layer straw colored, with many concentric whitish streaks. Apex a very small curved hook; posterior sinus but little concave, nearly half the shell's length, its membraneous margin thickened and broadly *reflexed* across the apex.

Length 56, breadth 40 mill.

Little Gasparilla Bay and Marco, West Florida (Heilprin and Willcox).

Aplysia willcoxi Heilpr., Proc. Acad. Nat. Sci. Phila., 1886, p. 364; Trans. Wagner Free Inst. Sci., i, p. 130, pl. 19 (bad).

This form agrees moderately well with d'Orbigny's *A. livida* in some respects, but it lacks the external light speckling, and the light

markings along the inner edge of swimming lobes are not nearly so regular as in *livida*. The more important structural characters of the latter, however, are still unknown. The whole scheme of coloring is unlike Rang's *protea*, which differs moreover in characters of the shell. That of *T. willcoxi* is uncommonly flat, with extremely slight, iridescent calcareous layer and wide cuticular borders. The description is from alcoholic specimens, as was that of Heilprin.

Var. PERVIRIDIS. Pl. 55, figs. 1, 2, 3, 4.

Length 14 cm. when living, 11 contracted in alcohol. Body large, much swollen behind. Anterior processes broadly folded above; tentacles conic and slit as usual. Swimming lobes very ample, free, united only at their insertion at the tail. Mantle large, its perforation extremely minute, with thickened edges but not tubular, surrounded by fine radial wrinkles, visible only under a lens (fig. 2, enlarged), the papilla being less than 1 mill. diam. Posterior right margin of mantle excised and folding into a short excurrent channel. Genital opening well forward, about as figured for *T. willcoxi*. Opaline gland 20–22 mill. behind genital pore, projecting externally as a pedunculated oval body in the type specimen (fig. 1), but perhaps evaginated, in which case it would have one large orifice.

Colors in life clear green on the head and tentacles, the swimming lobes olive-green with a coarse-meshed reticulation of black, subdivided by fine veins, irregularly maculated all over with light green, these spots having groups of white dots; the extruded mouth parts purple. In alcohol (for 10 months) it is grass green with black reticulation on the sides, caused by massing of the black veins through contraction; foot clear green; mantle green with some whitish clouds; inner surface of swimming lobes green and dirty whitish, marked with black in the sinus between lobes and body, the black extending well on the lobes toward the hind end; no noticeable black markings at inside edges of lobes.

Shell large, depressed, thin, yellowish, with fainter concentric growth wrinkles and coarse faint radii. Calcareous layer thin, the cuticular layer projecting far beyond it. Apex only moderately incurved, the epidermis reflexed across it as in *T. willcoxi*. Sinus shallow and wide. Length 60, breadth 52 mill.

Cape May, New Jersey (H. Lemon).

This form differs from *T. willcoxi* in lacking the characteristic pattern of dark marking, and in the longer excision or sinus of the shell. The animal colors the alcohol in which it is preserved green. The single specimen was found alive at Cape May in October, 1894.

T. CAILLETI Deshayes.

Nearly as large as *A. depilans*. Irregularly marbled with greenish-brown, very sombre, on a ground of white washed with brownreddish; the free edges of the mantle [swimming lobes] bordered with a wide zone of the same color but paler. (*Desh.*, Journ. de Conchyl., 1857, p. 140.)

Guadeloupe (Schramm).

No other information has been published on this form.

T. BRASILIANA Rang. Pl. 38, figs. 3, 4, 5.

Length 11 to 13 cm. Very much swollen, elongated in front, somewhat shortened behind, carrying the mantle far back. *Tube of the mantle quite ample and conspicuous.* Swimming lobes very large. *Color deep brown.*

Shell oblong, of a dark yellow color, the apex little developed; posterior sinus almost wanting.

Bay of Rio Janeiro, abundant (Quoy & Gaimard).

Aplysia brasiliana RANG, Hist. Nat. de Aplysiens, p. 55, pl. 8, f. 1–3 (1828).

Rang's figures and description which I give above are evidently from alcoholic specimens. He writes: Two quite remarkable characters distinguish *A. brasiliana* from the other species: first, the front part, is much lengthened, and the posterior part is rather short; and second, the opercle [mantle] is placed far toward the hind end, and consequently obliquely towards the tail. To these characters we may add the color of the lobes, which is a dark brown, and the form of the posterior tentacles which are perfectly conical, while the others are much widened. The lobes are ample and long and the opercle quite large. The shell, too, is distinct; it is of an oblong shape, and an obscure-yellow color; its lower surface is covered by a quite thick calcareous layer, the apex is little formed, and there is almost no sinus. The type is *Aplysia* No. 11, of the anatomical cabinet of the Garden of Plants.

T. FLORIDENSIS Pilsbry, n. sp. Pl. 37, figs. 15, 16, 17, 18, 19.

Length about 9½ cm. Body rather short, with short tail. Head lobes broad and triangular, the mouth parting their lower median

ends, distal extremities with the fold short. Tentacles small, conic, conspicuously slit. Swimming lobes ample, free, united behind only at their union with the foot. Mantle large and convex, smooth, with *a small central thin-edged perforation.* Posteriorly having a conspicuous, large excurrent siphon formed by a broad enlargement of the free mantle edge. Genital pore under forward right border of mantle surmounted by a fleshy prominence. Opening of opaline gland large, single, *about* 12 *mill. back of genital pore, and well under the gill.* Penis, when extended, about 28–30 mill. long, swollen at base, then tapering.

Color deep *purple-black,* the inside of swimming lobes slightly lighter, *blotched at the edge with black.* Mantle purple-black, *spotted irregularly and indistinctly with lighter fleshy-purple.*

Shell rounded, very convex, posterior sinus wide, concave; the apex well hooked and calloused, the membraneous layer reflexed behind it, cuticular layer sepia-brown; membranous margin wide below; calcareous layer rather thin. Length 39, breadth 34 mill.

Key West, Florida (H. C. Machette).

This form, which, on account of the general color of the body, I at first regarded as a probable variety of Rang's *A. brasiliana,* differs from that species in the greater proportional size of shell to total length of the animal, the maculated mantle and inside edges of the swimming lobes, the simple, thin edged mantle foramen (that of *brasiliana* being figured as tubular), and the wider, rounder shell. The types are two well preserved alcoholic specimens collected by Mr. Machette in 1893. They stain the liquor a dark smoky yellow.

T. PARVULA (Guilding) Mörch. Pl. 37, figs. 23, 24, 25.

Flaccid specimen: Body soft, slender, fusiform; epipodial lobes short, entire and continuous behind; eyes sublateral, in front of the bases of the tentacles. Tentacles slender, acute. Length 16 mill. (*Morch.*)

Contracted specimen: Body leathery, tough, transversely wrinkled and grooved; orifice in the mantle large, oval, and like the borders of the epipodial lobes, margined by a black line. Length 12 mill. Shell not seen in this specimen, but feels as in the preceding. (*Morch.*)

Shell small, rather solid, narrowly ovate or piriform, extremely convex; somewhat translucent white or brown tinted, more deeply so toward the lower margin. Apex strongly incurved, involute and

calloused, but with no reflexed margin over the tip. Sinus short and very concave, margined. Surface smooth. Calcareous layer coextensive with the excessively thin, hardly apparent cuticle.

Length 8½, breadth 6 mill.

St. Thomas (A. H. Riise; Dr. Hornbeck); *St. Vincent* (Guilding).

Aplysia parvula Guilding *MS.* in Mörch, Journal de Conchyliologie, 1863, p. 22; Mal. Bl. xxii, p. 176.—? *A. rosea* Rathke, Sowb., Conch. Icon. f. 23 (1869).

I have given Mörch's very poor descriptions of the soft parts of this species, and have diagnosed and figured the shell from part of the original specimens received from Mörch. It is unquestionably a distinct species, not closely allied to any other of the region. The shell is convex and solid, somewhat like *Crepidula convexa* Say in contour. The large oval orifice in the mantle is also a valuable distinguishing character, other described Antillean forms having this foramen minute or tubular.

Whether the *parvula* of Mörch is really Guilding's *mss.* species is by no means certain; but fortunately there is no necessity for raising the question. Sowerby has figured a shell from St. Vincent under the name *A. rosea* Rathke, which is the *A. parvula* of Guilding, according to him; but the real *A. rosea* was a Scandinavian species and in all reasonable probability a young *punctata* Cuv.

III. *Species of the West Coast of the Americas.*

a. Shell normal, with no accessory plate at the apex.
  b. Swimming lobes broadly united behind.
    c. Mantle excised behind, but with no tongue-like lobe.
      d. Mantle with a submedian perforation. Black, *nigra.*
      dd. Mantle with a large submedian oval orifice. Blackish, *rangiana.*
    cc. Mantle with a submedian perforation, and a posterior long, tongue-like siphonal lobe. Violet, with some white spots, blackish in alcohol, *inca*
  bb. Swimming lobes free to their union with foot behind.
    c. Mantle with a subcentral tube or papilla; swimming lobes very ample.
      d. Maculated; opaline gland with one orifice, *chierchiana.*

dd. Grayish-rose, each tentacle with a black line, *lessoni.*

ddd. Not so marked; slender, the tail long, *robertsi.*

cc. Mantle with subcentral minute pore, posteriorly bilobed; opaline gland with one orifice, *panamensis.*

aa. Shell with an accessory plate near apex; swimming lobes short, posterior, somewhat united behind; excurrent siphon long, with a tongue-like lobe; mantle with subcentral tube; opaline gland with one orifice. Finely netted with brown and spotted with black, *californica.*

T. NIGRA d'Orbigny. Pl. 22, figs. 10, 11.

Length as much as 25 cm. Body much elevated, leathery, strongly wrinkled, very ventricose. Head short and wide, the neck very short; buccal lobes broad, quite short, a little folded at the ends. Tentacles large, quite short, very obtuse and slit at the ends. Foot very wide, strongly wrinkled, thick, truncated in front, widened in the middle, short and subacuminate behind. Swimming lobes not very large, united behind for a moiety of their length, and forming a large branchial cavity; in front the lobes are so short that their free part can scarcely be of use in swimming. Mantle very large, in part concealed by the union of the swimming lobes, rounded, with a very small round aperture at the middle, above. Posterior edge of mantle not having a tongue-like lobe, but excised or sinused, and provided along the semicircle with a membranous ridge, perpendicularly elevated, corresponding to the sinus of the shell. Gill wholly covered by the mantle and by the bridge formed by union of the swimming lobes.

Color deep black, especially on the sole and lobes; the latter a little roseate inside.

Shell very open, depressed, with concentric and radial striæ; sinus wide and shallow; apex a little oblique and slightly encrusted. Amber colored.

Island of San Lorenzo, Callao, Peru.

A. nigra ORB., Voy. dans l'Amér. Mérid., p. 209, pl. 18, f. 1. 2.

This species is remarkable for its large size, the union of the swimming lobes behind, and the excised posterior margin of the mantle, which is not produced to form an efferent canal as usual in the genus. It emits a milky, white or slightly violaceous liquor in abundance, and has a very strong odor of musk.

Guppy (in Proc. Sci. Asso. Trinidad, ii, p. 137, and Proc. Victoria Institute of Trinidad, pt. 2, March, 1895, p. 123) reports this species from Trinidad, but there cannot be much doubt that the identification was erroneous.

T. RANGIANA d'Orbigny. Pl. 19, figs. 34, 35, 36.

Length of the larger individuals 3 to 4 cm. Body very short and elevated, oblong, quite leathery, much swollen; head wide; buccal tentacles broad and short, obtuse; foot oblong, wrinkled, truncate in front, very broad and rounded behind. Swimming lobes short, united behind for the greater part of their length, forming a deep sack. Mantle large, oval, without tongue-like process, the posterior margin with a fleshy circle elevated in perpendicular crests. A very large oval aperture in the mantle shows the shell. Gill partly covered.

Color in alcohol blackish.

Shell ovate, swollen, cretaceous, nearly smooth, the apex arcuate; yellowish.

Payta, Peru, in 6–7 fms., sand bottom (Dupetit-Thouars).

A. rangiana ORB., Voy. dans l'Amér. Mérid., p. 210, pl. 17, f. 11–13.

This species, Orbigny writes, has great affinity with *A. nigra*, and may prove to be the young of that; but the foot is not produced behind, and the aperture of the mantle is six times as large, although the individuals are not more than one-eighth the size of *A. nigra*. It was described and figured from alcoholic specimens.

T. LESSONII Rang. Pl. 56, figs. 15, 16, 17.

Length 17 cm. Body much elevated, fleshy; not as much elongated in front as in most other species, short and acute behind. Smooth and grayish-rose colored, with fine reddish lineolation. Foot oblong. Swimming lobes very large. Anterior tentacles thick and not very susceptible of extension; hinder tentacles lanceolate, marked in the middle by a black line extending their entire length. Mantle with *a small subcentral tube*, and terminating behind in a small, open siphon.

Shell oval, pointed behind, concave with little-developed apex; sinus long and not much arched. Inside white and covered with a calcareous layer; outer surface amber colored. Length 34 mill.

Payta, Peru (Lesson).

A. lessonii RANG. Hist. Nat. Aplys., p. 60, pl. 14.—LESSON, Voy. autour du Monde, etc., La Coquille, Zool., ii, pt. 1, p. 295 (1830).

T. INCA d'Orbigny. Pl. 19, figs. 29, 30, 31.

Extended animal as much as 20 cm. long. Moderately lengthened, elevated, flabby, very ventricose. Cephalic portion elongated, on a very short neck; buccal lobes very long and very wide, flattened and inrolled at the end, which is thin, sharp and strongly ridged. Tentacles long, subconic, obtuse and slit at the ends, placed slightly behind the middle of the interval between buccal and swimming lobes. Eyes visible, in front of the tentacles. Mouth placed at the lower part of the fissure separating the buccal lobes. Foot narrow, strongly wrinkled, acuminate behind. Swimming lobes very large, united and much prolonged behind the gill. Mantle swollen, oblong, smooth, *with a very small round aperture* in the middle; posteriorly it is produced in a very long, wide and thin tongue.

Color, a beautiful violet tint, with rounded white spots on the sides of the front part of swimming lobes, and several larger, more regular oblong and spaced on the neck and head, usually two behind the tentacles and four in front on each side, on a line with the forward insertion of the swimming lobes. Swimming lobes marked along the inside edge with a narrow border of clear rose-violet, flanked by large rounded and angular white blotches on a purple-brown ground. Mantle uniform violet. Gill purple violet. Preserved in alcohol this species retains the entire pattern of spots, but the ground tint becomes blackish, dotted with blackish.

Shell amber colored with corneous edge.

Callao Bay.

Aplysia inca ORB., Voy. dans l'Amér. Mérid., p. 207, pl. 14, f. 13. —*A. incus* SOWB., Conch. Icon., f. 28.

This species differs from *T. lessoni* in pattern of coloring, and the non-tubular mantle foramen.

T. CHIERCHIANA Mazzarelli & Zuccardi.

This new species is based upon two specimens from the island of San Lorenzo, Peru. The principal character of the species consists in the presence of a contractile, strongly-developed papilla in the center of the mantle, at the point where there is ordinarily an aperture. This papilla is swollen at base, narrowed toward the sum-

mit, forming a strongly serrate tuft. The opercule or mantle is ovoid, rather elongate, and presents a moderately-developed expansion on the right. Anterior tentacles are quite broad, plate-like, with sinuous, lobed margins, and are moderately separated. The posterior tentacles are conic and closer together. Swimming lobes strongly developed.

Genital orifice under the opercle in front of the gill. Opaline gland of the grape-bunch type, opening by one orifice.

Color: the body is bestrewn with numerous rather large oval dark maculæ, and spotted with smaller white spots.

Shell concave, elongate, rounded at the anterior extremity, the beak projecting and rounded; sinus notably arcuate.

Island of San Lorenzo, near Callao, Peru.

Aplysia chierchiana Maz. & Zuc., Bollettino della Società di Naturalisti in Napoli, ser. 1, vol. iii, p. 52 (1889).

T. panamensis Pilsbry, n. sp. Pl. 60, figs. 45, 46, 47, 48.

Length (of alcoholic specimens) 4 to 6 cm. Body soft, of usual proportions. Buccal lobes large, triangular-ear-shaped, with the usual fold above. Tentacles lance-shaped and slit. Swimming lobes thin, rather small, arising at the anterior third or two-fifths the total length, uniting behind only at their junction with the foot. Mantle transparent, with a very minute, scarcely visible pore; its posterior right margin bilobed and sinused to form an excurrent siphon. Genital pore and groove as usual. Opaline gland opening by a single conspicuous orifice.

Color grayish, with some ill-defined spots or rings, and marks of black posteriorly on the lobes. Mantle immaculate, but there are some faint, dark markings on inside of swimming lobes.

Shell moderately convex, buff outside, having a moderately solid calcareous layer within, the cuticle projecting but little beyond it. Apex acute, projecting, bearing a callous reflexed crest which forms a triangular cavity on the back. Sinus short and deeply arcuate. Surface with slight growth-wrinkles and impressed unequal, irregular, radial grooves, several on the left slope deeper. Length 16, breadth 13 mill.

Panama (J. A. McNeill).

The tentacles are comparatively slender and long; the swimming lobes weak, and the shell, with its hood at the summit, is about as solid as in *T. punctata* Cuv. No other West Coast or Antillean

species seems very nearly allied to this, unless it be the Antillean form of *T. dactylomela.*

T. ROBERTSI Pilsbry, n. sp. Pl. 55, figs. 4, 5.

Length (of alcoholic specimen) 11 cm. General form slender and lengthened; *the tail unusually long,* depressed, and extending far beyond posterior insertion of the swimming lobes. Neck and head elongated, the mouth in a vertical fissure as usual. Rhinophores conical, slit about half-way down, the minute, rudimentary eyes situated outward from them, but only a trifle anterior to the front of their bases. *Swimming lobes wholly free* from anterior to posterior insertions, moderately ample. Mantle having a minute, subcentral, conic tube; its free right border wide, produced in a folded lobe posteriorly, forming a rather long excurrent siphon. Opaline gland opening by a single large orifice. Foramen of the penis situated far forward, anterior to and below the right anterior tentacle, above the front edge of sole. Foot fleshy, the sole wide, emarginate in front.

Color (in alcohol) dirty light olive, very minutely wrinkle-reticulate with black-brown in places, forming a large cloud on the outside of each swimming lobe, another occupying the face; sole blackish; inner surface of swimming lobes blackish below, lightly stained in places outwardly. Mantle clear olivaceous over the shell, the free border and siphon blackish.

Shell thin, fragile, with very slight calcareous layer; buff outside; apex hardly curved, with a narrow reflexed margin. Sinus long, *nearly straight,* margined. Length 28, width 22 mill.

West coast of Mexico (Dr. W. H. Jones).

Notable features of this species are the unusually posterior eyes, anterior male genital pore, wholly free swimming lobes, and especially the long tail. The shell has a very thin calcareous layer, and the sinus is nearly straight. The type was in a bottle with *Dolabella californica* Stearns, which it resembles in color, at least in the alcoholic condition. The specific name is in honor of Mr. S. RAYMOND ROBERTS, whose services as an officer of the Conchological Section during a long series of years, are well known and appreciated by conchologists.

T. CALIFORNICA Cooper. Pl. 56, figs. 13, 14.

Length 37½, breadth and height 12½ cm. (*Cooper*). Length of alcoholic specimen described below 11 cm. Body obese, the ante-

rior portion long, swimming lobes inserted rather far back. Buccal lobes flattened and folded as usual, black within the fold. Posterior tentacles rather near together, conic and slit above, black within the slit, situated somewhat nearer buccal lobes than swimming lobes. Swimming lobes short and not very ample, united for a short distance behind. Mantle provided with a central minute tube; concentrically wrinkled; having an uncommonly long posterior excurrent siphon, the left lobe tongue-like and long.

Genital pore in the usual position; genital groove long. Opaline gland opening by a single large orifice.

Color "pale gray or greenish, becoming purplish on the side, folds of mantle with scattered white specks, from which an irregular net-work of brown lines extends over the rest of its body, interspersed with large brown blotches. Inner surface of [swimming lobes] varied with alternating painted bars of white and dark brown interlocking together. Sole of foot black. Eyes very minute and black." The alcoholic specimen before me is yellowish, finely netted and spotted all over the sides and back with black brown, sole blackish; mantle black-brown with large yellowish maculæ; inside of swimming lobes black-brown barred boldly with dirty yellowish, the dark bars branching at the upper edges of lobes.

"Shell cartilaginous, translucent, trapezoidal, or hatchet-shaped, margins rounded, slightly convex above, the nucleus in old specimens distant from the posterior end or apex. Faint radiating lines diverging from the nucleus, crossed by an irregular net-work of darker lines, all ending abruptly at some distance from the margin, which has thus a wide, nearly transparent border. An accessory plate arises on the inner surface from the nucleus, nearly spatulate in form and slightly raised." (*Coop.*). The shell of the specimen figured on my plate shows the essential features mentioned by Cooper, but the accessory plate projects squarely above the upper margin. The minute, incurved apex is situated some distance within the margin, being 4 mill. below the upper edge in the specimen figured.

Monterey to San Pedro, California.

Aplysia (*Neaplysia*) *californica* J. G. Cooper, Proc. Cal. Acad. Nat. Sci. iii, 1863, p. 57, fig. 14.—*Neaplysia californica*, J. G. Cooper, Geographical Catalogue of the Mollusca found west of the Rocky Mountains between lat. 33° and 49° N., no. 241, p. 14 (Geol. Surv. of Cal. 1867.)

The specimens before me are from Monterey. This species is well characterized by the short, poorly developed, posteriorly placed swimming lobes, the nearness of the tentacles to each other, the deep pocket-like gill cavity, and the accessory plate on the shell. A small specimen before me lacks the leopard-like spotting of the outside, being dirty gray with black maculæ around tentacles and toward the tail. The mantle is uniform grayish, but the inner surface of swimming lobes has the marking described above. In place of a tube, the mantle shows only a minute pore on a very slight papilla, surrounded by fine radial striæ. Whether these differential features are specific or not remains to be decided by the examination of more material.

IV. *Polynesian Species.*

A considerable portion of the species from this region are not sufficiently known to permit the construction of any useful synopsis or key.

T. BIPES Pease. Pl. 20, figs. 43, 44.

Oblong, smooth, elevately rounded above, compressed towards the foot. Neck long. Mantle lobes ample, thin, half the length of the animal, and rounded in outline. Dorsal tentacles small, grooved, and blunt. Oral tentacles large, strongly dilated, and united in front, forming a kind of veil, beneath which is the mouth. Eyes small, black, somewhat lateral, a little in advance of dorsal tentacles. Head rather flattened in front, convex in profile, with a groove extending from the muzzle along its side and over the back of the animal. Siphonal tube very large and prominent, and expanding outwards. Branchiæ exposed when the mantle is thrown on one side. Foot narrowed anteriorly, widest posteriorly and rounded; the foot is double; the posterior portion (of a circular shape) is smooth and projects slightly laterally and posteriorly, being quite distinct from the anterior portion, which is slightly rugose. Shell large, thin, flexible. Color brownish or brownish-olive, veined with dusky and clouded with white, or dusky slightly spotted with the same. Foot pale ash. (*Pse.*).

Shell compressed, obliquely subovate, concentrically wrinkled, within pearly-calcareous; apex elevated, acuminated, very little incurved; upper margin sloped downwards, rounded at the end;

outer lip anteriorly obliquely produced; dorsal and inferior margins very obliquely sloped forwards. (*Sowb.*).

Sandwich Is. (Pse.).

Syphonota bipes PEASE, P. Z. S., 1860, p. 23.—*Aplysia bipes* SOWB. Conch. Icon., xvii, pl. 6, f. 26a, b.

This species contracts itself when handled so as to form a ball. The young are subpellucid. The hinder part of the foot is evidently used as a sucker, by which the animal suspends itself. (*Pse.*).

T. SANDVICHENSIS Sowerby. Pl. 20, figs. 46, 47.

Shell obliquely oblong, arched, ivory, brown towards the edges, white within, apex elevated, very little incurved; upper margin sloped downwards, deeply excavated, angular at the end; outer lip roundly produced below; dorsal margin convex, inclined towards the outer lip below, widely excavated. (*Sowb.*).

Shores of Sandwich Islands (Cuming).

Aplysia sandvichensis SOWB., Conch. Icon., xvii, pl. 4, f. 14a, b (August, 1869).

"Much more arched than *Aplysia tigrina*." But it may be only the shell of a fully adult *T. bipes* Pease.

T. GRANDIS Pease. Pl. 20, figs. 40, 41.

Body long, smooth, elevately rounded above and rather compressed along the sides. Mantle lobes thin, rounded, much dilated and strongly undulated along the margins. Dorsal tentacles rather large, pointed, dilating outwards and grooved. Oral tentacles grooved, about same size as the dorsal, with a furrow extending from beneath the right one along the neck and terminating in the back between the mantle lobes. Foot elongate, narrow, corrugated, and projecting posteriorly, where it is rounded. The siphonal tube is on the posterior lateral portion of the back, canaliculated and curved, and extending above the back. Shell large, covered by a thin membrane, ovately rounded, thin, fragile, with rugose lines of growth, a deep rounded sinus on the right side near the apex. Apex small and callous. Color purplish-brown, pale along the flanks, everywhere above densely crowded with minute white dots, which on the sides are arranged in circular clusters forming spots. Foot pale. The young are of a very pale color. (*Pse.*).

Shell somewhat talon-shaped; oblique, arched, brownish-green, subpellucid; apex very elevated, acuminated, subauriculated; upper margin much sloped, excavated, outer lip rounded; lower margin rounded; dorsal margin convex, subangulated. (*Sowb.*).

Sandwich Is. (Pease).

Syphonota grandis Pse., P. Z. S., 1860, p. 23.—*Aplysia grandis* Sowb., Conch. Icon., pl. 8, f. 34a, b.

This species was found gregarious on a rocky bottom. They generally carry the mantle lobes expanded, spreading open and exposing the shell and branchiæ. When confined in a glass jar, they used the posterior portion of the foot as a sucker, suspending themselves from the glass, although there was no division of the foot, as in the preceding species. (*Pse.*).

T. elongata Pease. Pl. 59, figs. 35, 36, 37, 38.

Length (of alcoholic specimens) about 2 cm. Form oblong, smooth. Back elevated, so much so as to give it a slightly compressed appearance. Mantle lobes strongly dilated and undulated, and free nearly the whole length of the back. Dorsal tentacles rather slender, and ear-shaped; anterior pair large and dilated. Foot narrow and terminating in a point posteriorly, which projects beyond the back. Color of a darker or lighter brown, which color is most intense on the top of the head and neck, The whole dorsal region is clouded and minutely speckled with white. The shell is distinctly defined in the living animal being covered with a thin translucent membrane. (*Pse.*).

Swimming lobes narrow, membranous, united for a short distance behind. Mantle having an *extremely large oval foramen;* excised and lobed behind. Genital pore and groove as usual.

Shell extremely large for size of the animal, moderately solid, buff outside; calcareous layer nearly as extensive as the cuticular. *Very convex,* the apex incurved, *bearing a wide, reflexed and adnate callous hood.* Sinus *very deeply concave* and short. Length 11½, breadth 8 mill.

Sandwich Islands (Pse.; Townsend).

Siphonota elongata Pse., P. Z. S., 1860, p. 24.—Mart. & Langk. Donum Bismarckianum, p. 54, pl. 3, f. 6.

This seems to be a species allied to *T. punctata* and *parvula,* having the shell of the same convex form, although provided with a

much more developed "hood." The mantle foramen is extremely large, judging from the rather poor alcoholic specimens before me. I see no pore of the opaline gland, and it is probably multiple, as in *T. punctata*. My specimens are yellowish-gray, duskier in front, with some blackish on the head.

T. VIRIDESCENS Pease. Pl. 25, fig. 3.

Length 30 cm. Animal elongate, smooth; dorsal region, moderately elevated, slightly convex in its outline, terminating abruptly posteriorly, beyond which the foot extends but a short distance, ending in a rounded point. Head depressed, neck long; labial tentacles large, broad, much dilated; cervical tentacles moderate in length, stout, cylindrical, grooved their whole length on the outer sides. Eyes immersed, a short distance in advance of the base of the cervical tentacles. Siphon large, recumbent, long, corrugate transversely near its termination. Ground color pale green mottled with white, and dusky, whole surface reticulate with fine black lines, and ornamented with remote, large, diffused dusky rings. Foot greenish flesh color, slightly mottled with dusky, upper sides of the posterior portion black. (*Pse.*).

Shell undescribed.

Kingsmill Is. (Pse.).

Syphonota viridescens PSE., Amer. Journ. of Conch. iv, p. 77, pl. 10, f. 1 (1868).

A large species "length one foot," which will probably retain in alcohol the dusky rings described by Pease.

T. SOREX Rang. Pl. 22, figs. 1, 2, 3, 4, 5.

Length 2·5 cm. Body short, oblong and much swollen; mantle thick and a little rough; foot large and callous; lobes narrow. Opercle with a median tube.

Color deep green, marbled with black spots. (*Rang*). Dirty green, marbled or spotted with black, foot olivaceous. (*Less.*).

Shell very thin and not very concave, oval-oblong, yellow outside, white within; the sinus rather shallow, and *situated far back.* Length 25 mill.

Island of Oualan (Ualan), Caroline group (Lesson).

Aplysia sorex RANG, Hist. Nat. Aplys., p. 57, pl. 10, f. 4–8.—LESSON, Voy. autour du Monde, La Coquille, Zool., ii, pt. 1, p. 294.

This small sized species is especially remarkable for its short form, extremely swollen back, acute tail and short anterior portion. The foot is very broad and spreading in front, thick and rugose. The swimming lobes are narrow and close on the back, and do not cover it entirely. The opercle or mantle is quite large and oblong.

T. PEASEI Pilsbry, n. n. Pl. 25, fig. 2.

Animal oblong, slender, smooth, dorsal region much elevated, convex in outline, gradually sloping posteriorly to the termination of the foot, anteriorly abrupt; neck long; cervical tentacles slender, long and cylindrical; labial tentacles large, moderately dilated. Siphon large, erect. Color pale fawn, mottled with darker, and covered with minute crowded white and very light purple dots; under portion of the body, edges of the mantle and labial tentacles margined with dark slate color. (*Pse.*).

When in confinement it adhered with considerable tenacity to the jar by the hinder portion of the foot. (*Pse.*).

Huahine, Society Is. (Pse.).

Syphonota punctata PSE., Amer. Journ Conch., iv, p. 77, pl. 9, f. 2 (1868). Not *Aplysia punctata* Cuvier.

The size is not stated by Pease, but judging from his figure it is a small, long-tailed form with long excurrent siphon. The shell is undescribed.

T. KERAUDRENII Rang. Pl. 39, figs. 1, 2, 3, 4.

Length 15 cm. Oblong, very much swollen, not much elongated forward, acute behind; swimming lobes very large; opercle [mantle] vast, oblong, with a very distinct tube in the middle; the siphon long and open lengthwise. Smooth and greenish-brown with large irregular and close black spots. Anterior tentacles wide with wavy borders, posterior tentacles conic.

Shell large, oval, not very concave, elongate, much narrowed behind, the sinus long and rather shallow; apex triangular, recurved and thick; calcareous layer quite thick. Color brown-yellow above, white below. Length 48 mill.

Tahiti (*Otaheite*), *Society Is.* (Lesson).

Aplysia keraudrenii RANG, Hist. Nat. Aplys., p. 59, pl. 13.—LESSON, Voy. autour du Monde, etc., La Coquille, Zool., ii, pt. 1, p. 294.—Not *Syphonota keraudreni* ANGAS, P. Z. S., 1867, p. 228.

A large, handsome species, with ample swimming lobes, large mantle provided with a conspicuous central tube and an uncommonly long excurrent siphon. Angas reports it from Port Jackson, but the identity of his specimens with the type collected at Tahiti by Lesson, is open to grave doubt. See under *T. angasi* Sowb.

T. PULMONICA Gould. Pl. 18, fig. 28.

Length six inches; height two inches. Body oblong, posteriorly sacciform, with a short, distinct prolongation of the foot backwards. Color bronze-green, coarsely reticulate with dark veins; siphonal aperture small; head obtuse, slightly bilobate; anterior tentacles short, ear-shaped; cervical tentacles acutely conical, faintly annulate. (*Gld.*).

This animal bears a general resemblance to *A. tongana* of Quoy and Gaimard; but their figure shows the ruffled posterior disk peculiar to the subgenus *Dolabella*, no traces of which are apparent in this species. (*Gld.*).

Tutuilla, Samoa Islands.

Aplysia pulmonica GOULD, U. S. Exploring Exped., p. 223, fig. 268 (1852).

The more essential structural characters of this species are unfortunately unknown. Compare *T. tryoniana* and *T. keraudrenii.*

Var. TRYONIANA Pilsbry, n. v. Pl. 57, figs. 54, 55, 56, 57.

Length (of an alcoholic specimen) about 13 cm. Body of ample width. Buccal lobes and tentacles as usual, the later stout-conic, near together. Swimming lobes arising at about the anterior third, long, very ample, united behind at their junction with foot; anterior insertions widely separated. Mantle large, with a minute submedian pore on a very low, hardly noticeable papilla, surrounded with short black wrinkle-rays, star-like. Free right border of mantle wide, abruptly narrowed toward the posterior end, excised, and terminating in a fold forming a well defined excurrent siphon.

Genital orfice and groove as usual, the latter deep with overlapping left margin. Orifice of opaline gland a large pit about 11 mill. behind genital pore.

Color (of alcoholic specimen) externally a dirty light olive, much and irregularly clouded and mottled with black on the anterior half, less so posteriorly; with a crinkly-reticulation of black throughout.

Mantle dirty white, with slight gray clouds, its free right margin (inflexed and not shown in figure) olive with bold confluent maculæ of black. Inner surface of swimming lobes olivaceous, boldly marked with confluent black maculæ, the lighter tint prevailing toward edges of the lobes. Sole uniform olivaceous.

Shell moderately convex, ovate, yellow outside, becoming brownish toward the margins, the epidermal layer projecting well beyond the moderately solid, white, calcareous layer. Beak well incurved, enveloped by a very ample callous, reflexed "hood" which is not adnate dorsally but leaves a large, deep, triangular cavity (fig. 24). Sinus rather short and moderately concave, its inflexed cuticular margin conspicuous and nodular above. Surface with inconspicuous growth striæ and many shallow radial grooves. Length 54, breadth 45 mill.

Upolu, Samoa Is. (Dr. Gräffe).

Aplysia sp.? Museum Godeffroy, Catalog IV, p. 105, No. 1107a. Hamburg, 1869.

This form, which I name in honor of the founder of the Manual, is allied to *T. keraudrenii* in size, coloration and ample proportions of the swimming lobes. It differs from that in the star-like pore of the mantle, in place of a conspicuous tube, and in the greater development of the reflexed callus at the shell's apex. The posterior sinus of the shell, too, is shorter; and the excurrent siphon of mantle is rather less developed, although of the same essential structure. *T. pulmonica* Gld. is also a species of similar characters, but it apparently has a more extensive posterior union of the swimming lobes, producing the sack-like structure described by Gould, and it lacks black maculation.

V. *Species of New Zealand and Australian Seas.*

These forms are still too imperfectly known to admit of tabulation in the form of a "key."

T. BRUNNEA Hutton. Pl. 59, fig. 44.

Animal of a uniform rich dark brown, about 4 inches in length. Shell horny, ear-shaped, firm, the whole shell very finely concentrically striated; epidermis pale brown. Length ·9, breadth ·7 inch. The shell somewhat resembles *A. excavata* Sow., from Port Jackson, but it is not square at the end. (*Hutton.*)

Wellington and Dunedin, New Zealand.

Aplysia brunnea Hutt., Trans. N. Z. Inst., vii, p. 279, pl. 21, fig. (1875); Man. N. Z. Moll., p. 123.

T. venosa Hutton. Pl. 59, fig. 39.

Animal yellowish-brown, veined with dark brown, about 6 inches in length. Shell membranous; the apex rather coarsely concentrically striated, the rest of the shell smooth and polished; epidermis pale straw color. Length 1·25, breadth 1 inch. (*Hutton*).

Wellington, New Zealand.

Aplysia venosa Hutt., Trans. N. Z. Inst., vii, p. 279, pl. 21, fig. (1875).

T. tryonii Meinertzhagen.

Animal a dark brown (kelp color), spotted all over with gray pepper colored spots. The edges of the lower lobe of the mantle marked evenly with alternate darker brown and gray. The lobe covering the shell striped with gray, all of which stripes point to, and narrow towards, the apex of the shell. Posterior sides of upper tentacles also a peppery gray color. Shell faintly but finely striated concentrically, horny and flexible at the edges.

Length of shell 1·15 inches, breadth 0·65 in. Length of animal about 5 inches.

The above animal appears to me to differ in coloring from *A. brunnea*, described by Capt. F. W. Hutton. The shell also appears to me to differ in its measurements from those given by Capt. Hutton, and in appearance from that figured in his plate, being much longer in comparison with its breadth. The coarse striations and shape of the shell of *A. venosa* leave no doubt that my specimens differ from that animal.

All my specimens discharged the purple fluid (which is characteristic of the genus) on being placed in fresh water, or otherwise annoyed. I noticed also that the lower lobes, which some authors say are used in swimming by this genus, are only used in that way by this species in a very qualified sense. They attach themselves to a rock or to sea-weed by their tails, and allow their bodies to drift about, simply guiding the direction of their bodies, and maintaining their upright position, by the movement of the lobes.

As in *Parmophorus*, *Bulla* and *Haliotus*, the shells of younger individuals were much larger in relation to their bodies than those of mature age. (*Meinert.*)

Waimarama, Hawke's Bay, and Napier, New Zealand.

Aplysia tryonii MEINERTZHAGEN, Trans. and Proc. N. Z. Inst., 1879, xii, p. 271, 270 (1880).—HUTTON, Tr. N. Z. Inst., xv, p. 118, pl. 13, fig. A (Dentition).

The formula of teeth given by Hutton is 13·1·13, an unusually small number. In form, the teeth offer nothing especially characteristic.

T. HAMILTONI Kirk.

Animal about 7 inches in length, 2½ inches high, and weighing 14 oz. Color umber-brown, with fine irregular dark markings; lighter below. Shell ear-shaped, horny, firm, ribbed on left side, irregularly concentrically striated; epidermis bright straw color, highly polished. Inside white, with a pearly luster. Length, 1·6, breadth 1·45 inch. (*Kirk.*)

Napier, New Zealand.

Aplysia hamiltoni KIRK, Trans. N. Z. Inst., 1881, xiv, p. 283 (1882).

T. TASMANICA Tenison-Woods.

Shell thin, fragile, translucent, shiny, obliquely subquadrate, slenderly concentrically striate, and transversely minutely sulcate, subtestaceous within, slightly concave, enamelled, horny; apex scarcely incurved, with the upper margin arcuate and subreflexed, lower margin oblique and straight, anteriorly produced and rounded. Length 38, breadth 28 mill. (*T.-W.*)

Tasmania.

Aplysia tasmanica T.-W., Papers and Proc. and Rep. Roy. Soc. Tasm. for 1875, p. 156 (1876).

A large form of talcous appearance, the margin becoming insensibly membranaceous. It is somewhat similar in form to *A. gigantea* of Sydney, but more oval, membranaceous, and smaller. (*T.-W.*)

T. NORFOLKENSIS Sowerby. Pl. 59, figs. 42, 43.

Shell horny, brown, arched, ventricose, obliquely subovate, thin, smooth; apex elevated, round, auriculated at the back; upper margin sloped, excavated; outer lip rather convex; lower margin rounded, dorsal margin arched, rounded, thinly reflected near the apex, obliquely inclined towards the lower end. (*Sowb.*)

"*Norfolk Island, New South Wales*" (Sowb.); *Shark Island, Port Jackson* (Brazier).

Aplysia norfolkensis Sowb., Conch. Icon., pl. 10, f. 42a, b (Aug., 1869).—Angas, P. Z. S., 1877, p. 190.

The auricle produced by the reflected dorsal margin is more expanded in *Aplysia concava* than in this similarly shaped but differently colored shell. (*Sowb.*)

T. concava Sowerby. Pl. 43, fig. 27 (enlarged).

Shell small, straw-colored, thin, ventricose, transverse, smooth, white within; apex small, rounded, strongly incurved, subauriculated on both sides, upper side concave, short; dorsal margin reflected, elevated, oblique, sloped towards the outer lip. (*Sowb.*)

Australia (Sowb.).

Aplysia concava Sowb., Genera of Shells, fig. 3.—*A. concava* Sowb., Conch. Icon., pl. 6, f. 24a, b.

Aplysia anguilla is more transverse, and *Aplysia rosea* more triangular than this species, although they nearly resemble it; the apex is auriculated, and the reflected lateral margins near it (*Sowb.*)

Much like *elongata* Pse., *norfolkensis* Sowb., and *parvula* Guild. I suspect it to be identical with one of the latter species, notwithstanding the locality given by Sowerby. The original figure measures 9½ mill long.

T. excavata Sowerby. Pl. 58, figs. 32, 33.

Shell pale, thin, subquadrate, scarcely oblong, concentrically striped, ventricose, within thinly testaceous, apex not prominent, thin, roundly incurved; upper margin short, scarcely excavated, square at the end, outer lip rather straight; lower margin square; dorsal margin very thin, convex. (*Sowb.*)

Port Jackson (Angas),

Aplysia excavata Sowb., Conch. Icon., xvii, pl. 3, f. 8a, b (Aug., 1869).—Angas, P. Z. S., 1877, p. 190.—*Aplysia hyalina* Sowb., *t. c.*, pl. 4, f. 13a, b,—Angas, *l. c.*

Aplysia excavata and *hyalina* were described from shells only, and these are so similar that I believe them to belong to one species. The description of *hyalina* is a follows:

Aplysia hyalina (pl. 58, figs. 30, 31). Shell round, pellucid, hyaline, ventricose, thinly concentrically ridged; back convex, with a sulcus near the margin; apex depressed, rounded, incurved; upper margin elevated, rounded at the end; outer lip convex; dorsal mar-

gin convex, reflected; lower margin round. A beautifully transparent, rounded, ventricose shell, much differing from other known species. (*Sowb.*)

Port Jackson, at Lane Cove (Brazier).

T. SYDNEYENSIS Sowerby. Pl. 57, figs. 22, 23.

Shell compressed, perpendicularly oblong, chestnut in the middle, pale horn near the margins; apex obtuse, terminal, reflected, incurved; upper margin straight; outer lip straight; lower margin subquadrate; dorsal margin convex. (*Sowb.*)

Shark Island, Port Jackson (Brazier).

Aplysia sydneyensis SOWB., Conch. Icon., pl. 7, f. 31a, b (August, 1869).—ANGAS, P. Z. S., 1877, p. 190.

The shell of this species has some resemblance to that of a *Pleurobranchus.* (*Sowb.*).

Considerably like *T. excavata,* but narrower.

T. ANGASI Sowerby. Pl. 57, figs. 18, 19.

Shell compressed, thin, smooth, subtrigonal, arched, pale brown, very slightly testaceous, concentrically striped towards the apex; apex elevated acuminated, cuneate; outer lip produced below; dorsal margin convex, sloped towards the ventral margin. (*Sowb.*)

"Sow and Pigs" Reef, Port Jackson (Brazier).

Aplysia angasi SOWB., Conch. Icon., xvii, pl. 8, f. 35a, b.—ANGAS, P. Z. S., 1877, p. 190.—*Aplysia keraudreni* SOWB., Conch. Icon., pl. 1, f. 2a, b.—*Syphonota keraudreni* ANGAS, P. Z. S., 1867, p. 228. Not *A. keraudrenii* Rang, 1828.

Flatter than the shell of *Aplysia depilans,* which it much resembles. It is thinner at the edges, and the apex is not at all callous, but pointed and incurved. The dorsal margin is more rounded. (*Sowb.*)

With *A. angasi* I am disposed to unite *A. keraudreni* of Sowerby's Monograph, which differs markedly from the *keraudrenii* of Rang in the shorter sinus, etc.

T. SOWERBYI Pilsbry, n. n. Pl. 57, figs. 20, 21.

Animal olive, mottled with black. Shell internal, thin, horn color, oblong, produced and curved at the apex. Length 1 inch, 3 lines, breadth 10 lines. (*Angas.*)

Shell oblong, thin, subtrigonal, pale, oblique, hatchet-shaped, arched, tumid, sinuously striped near the umbones, within thinly tes-

taceous; apex elevated, incurved, with a small callus, widely reflected; upper margin sloped downwards, arched, excavated, rounded at the end; outer lip anteriorly sinuously produced, dorsal margin obliquely arched, excavated. (*Sowb.*)

The lower part of the dorsal margin, corresponding with the canal in spiral shells is much excavated. This is the species to which was first applied by Pline the name of *Lepus marinus* or Sea Hare. (*Sowb.*)

Middle Harbor and Coodgee Bay, Port Jackson (Angas).

Aplysia tigrina Rang, Angas, P. Z. S., 1867, p. 228.—Sowerby, Conch. Icon., xvii, pl. 2, f. 5 (1869). Not *A. tigrina* Rang.

The shell is longer, with shorter sinus than that of the true *tigrina*. Sowerby's acute remark that this species is the *Lepus marinus* of Pliny must be taken for what it is worth. I support it only to the extent of agreeing that the animal is at all events a *Lepus marinus*.

T. gigantea Sowerby. Pl. 58, figs. 28, 29.

Shell large, expanded, convex, obliquely subquadrate, greenish-brown, concentrically undated and minutely striped, within a little testaceous, very pale rose; apex elevated, very little incurved, upper margin wide, lightly arched, excavated; inferior margin oblique, not excavated, anteriorly obliquely produced. (*Sowb.*)

Swan River (Cuming).

Aplysia gigantea Sowb., Conch. Icon., pl. 1, fig. 1a, b (Aug., 1869).

T. denisoni Smith.

Body (in spirit) high, exhibiting a distinct pedal disk, produced posteriorly into a caudal termination. The entire surface wrinkled, dirty-whitish, black-veined in the wrinkles (? stains only). Mantle-lobes moderately large, commencing in front, some distance behind the posterior tentacles and terminating a little in advance of the cauda. Anterior tentacles large, cylindrical, with the apical slit not extending half way down the outer side, placed a little nearer the oral tentacles than the beginning of the mantle lobes. Eyes minute, situated near the outer anterior base of tentacles.

Shell very thin, straw color, 30 millim. long and 27 broad.

Animal about three inches in length in its contracted state (*Smith.*)

Port Denison, Queensland (Coppinger)

Aplysia denisoni Smith, Zool. Coll. H. M. S. Alert, p. 89 (1884).

This species is remarkable for the large size of the oral tentacles. (*Sm.*)

T. SPARSINOTATA Smith.

Animal about 45 mill. in length, of a pale color in spirit, varied with a few dark distant dots along the sides, caudate posteriorly. Middle of back between the mantle lobes in front of the shell, also the inner surface of the anterior portion of the lobes themselves, exhibiting irregular brownish patches. Lobes commencing a short distance behind the dorsal tentacles, and terminating behind at about the same distance from the end of the body. Oral tentacles moderately large and long; posterior conical, acuminate, not far apart.

Shell elongate, rather beaked behind, sharply arcuate in front, 15 millim. long, 10 broad. (*Smith.*)

Thursday Island, Torres Straits, 4–5 fms. (Coppinger).

Aplysia sparsinotata SMITH, Zool. Coll. H. M. S. Alert, p. 89 (1884).

VI. *Species of the East Indies, China and Japan.*

T. GEOGRAPHICA Adams & Reeve. Pl. 25, fig. 1.

Whitish-brown, covered with minute dark specks, and large, irregular, green reticulated patches, margined with opaque white; under surface of foot of a bright yellow; left side of foot with a projecting lobe [swimming lobe] which overlaps that of the opposite side; siphon of the mantle prolonged into a tapering, subcylindrical tube. Shell nearly membranaceous. (*A. & R.*).

Java Sea, among floating fuci (*Ad.*).

Siphonotus geographicus A. & R., Zool. Samarang, p. 64, pl. 18, f. 1 (1848).

This species is type of the genus *Siphonotus* Adams & Reeve, founded for Aplysias with the mantle produced to form a posterior excurrent siphon. The variations from a short to a long tube in various species render it impossible to give this character more than specific value.

T. CORNIGERA Sowerby. Pl. 20, fig. 45.

Shell talon-shaped, narrow, ovate, arched, concentrically striped; apex much elevated, incurved, acuminated, callous; upper margin depressed, excavated, obtusely angular at the end; outer lip sinuously obliquely produced below, lower margin a little acuminated

in front; dorsal margin round, reflected, with a radiating groove. (*Sowb.*).

Zebu, Philippines (Cuming).

Aplysia cornigera SOWB., Conch. Icon., pl. 9, f. 40 (1869).

The curved horn-like form and pointed apex distinguish this prettily striped shell. (*S.*).

T. FUSCA Tilesius. Pl. 59, fig. 34.

Length 9 cm., swollen, oblong, brown and spotted; mantle with the foramen radiated; foot oblong, narrow; swimming lobes moderately ample; tentacles folded as usual. Shell fragile, flexible.

China, living on sea-weed, etc., along the shore.

Aplysia fusca TILESIUS, in Krusenstern's Voyage around the World in 1804–1806, p. ?, pl. ?. (*Russian*, 3 Vols. 4to, St. Petersb., 1809–1812, and Atlas in folio, 1813).—RANG, Hist. Nat. Aplys., p. 65, pl. 18, f. 1.—DESH. in Lam., An. s. Vert., vii, p. 696.

I have not seen Admiral Krusenstern's Voyage, and have, therefore, given Rang's translation of the description and copied his reproduction of the original figure. The species resembles *T. depilans* in having a large oval mantle orifice, with radiated borders.

T. ORIENTALIS Sowerby. Pl. 18, fig. 25.

Shell ovate-subtrigonal, rather solid, chestnut, tumid in the middle of the back, calcareous within; apex elevated, biauriculated; upper margin sloped, scarcely excavated, obtusely angular at the end; outer lip rather straight above, rounded below; dorsal margin straight, elongated; lower margin round. (*Sowb.*).

Chinese Seas (Cuming).

Aplysia orientalis SOWB., Conch. Icon., pl. 5, f. 18 a, b (1869).

This shell nearly resembles *Aplysia punctata* in form, although less triangular. It has a slight bluish tint in coloring.

T. SINENSIS Sowerby. Pl. 18, figs. 26, 27.

Shell thin, hyaline, arched, quadrate, concentrically finely ridged; apex nearly terminal, small, biauriculated; upper margin straight, arched, obtusely angular at the end; outer lip a little convex, dorsal margin reflected, sloped below. (*Sowb.*).

Chinese Seas (Cuming).

Aplysia sinensis SOWB., Conch. Icon., pl. 7, f. 29a, b (1869).

The whole shell is laterally much curved.

T. MARMOREA A. Adams.

A large species, sometimes 10 inches long. Back elevated; swimming lobes large, ample, marbled with green and white; anterior tentacles very broad, truncate; posterior tentacles sublinear, obtuse. Shell large, thin, fragile, much dilated in front; apex scarcely involute, somewhat thickened. (*A. Ad.*).

Port Hamilton (*Mah-lu Sau*), tidal pools and taken in the seine (*Ad.*).

Aplysia marmorea A. AD., Annals and Magazine of Natural History, Series 3, viii, p. 140 (August, 1861).

T. MARGINATA A. Adams.

Back elevated; swimming lobes large, dilated, white edged, and then with a brown margination; reddish-brown, variegated and dotted with brown. Anterior tentacles broad, short, truncate; posterior small and subacute. Shell fragile, thin, semimembranous, subtriangular, dilated and rounded anteriorly; apex scarcely involute. (*A. Ad.*).

Port Hamilton in rock pools at low water (*Ad.*).

Aplysia marginata A. AD., Ann. Mag. N. H. (3), viii, p. 141, (Aug., 1861).

T. FIMBRIATA Adams & Reeve. Pl. 18, figs. 20, 21, 24.

Anterior tentacles with a sinuous, fringed margin from the outer end to the head; posterior tentacles bent toward the apices, deeply slit. Obscure greenish, with very many eye-spots, with minute white pupils and brown irides; ornamented with black anastomosing lines and minute opaque white dots. (*A. & R.*).

Shell oblong-subquadrate, pale, concentrically striped in every part, thin, subventricose, very thinly testaceous within, apex a little elevated, incurved, scarcely callous, upper margin slightly excavated, lineate at the end; outer lip rather straight, subquadrate at the end, dorsal margin convex, lower margin rounded. (*Sowb.*).

Miyako-jima Island (*Taipinsan* or *Typinsan* of some charts), *Further Loo Choo group.*

Aplysia fimbriata A. & R., Zool. Samarang, Moll., p. 63, pl. 17, fig. 2 (1848).—SOWERBY, Conch. Icon., pl. 4, f. 12a b.

Inner surface of foot, when seen expanded, marbled with black and white. This large and handsome species is remarkable for the

dilated and fringed anterior tentacles and for the peculiar notched and inflexed character of the posterior tentacles. It was found crawling among the fuci in small pools left by the receding tide on the flat coral shores of Typinsan, one of the Meiacoshima group (*A. Ad.*).

T. LÆVIGATA Stimpson.

Smooth, convex, oblong, somewhat produced anteriorly; lobes of the mantle rather short; siphon conical; foot with a blunt posterior termination; dorsal tentacula cylindrical, orals dilated at their extremities. Color, brownish above, sides with small dark gray spots and a few patches of white punctæ; head and foot green. Shell suboblong, very thin and membranaceous, of a pale horn color; arcuated incision short but deep; summit triangular, small, thick and callous. Length 2 inches. (*Stimp.*).

Ousima (U. S. N. P. Exped).

Aplysia lævigata STIMP., Proc. Acad. Nat. Sci. Phila., 1855, p. 378.

T. JAPONICA Sowerby. Pl. 18, fig. 22, 23.

Shell obliquely ovate, subpellucid, obscure chestnut, within very little calcareous, back tumid in the centre, with a slight rib and depression near the dorsal margin; apex elevated, much incurved, biauriculated; upper margin sloped, deeply excavated, short, rounded at the end; outer lip round, lower margin subquadrate, dorsal margin a little arched. (*Sowb.*).

Japan (Cuming).

Aplysia japonica SOWB., Conch. Icon., xvii, pl. 5, f. 16a, b (1869).

The biauriculated character of the apex is produced by the curving of the lateral margins on each side. (*Sowb.*).

VII. *Species of the Western Indian Ocean, Red Sea to the Cape.*

The more important external structural characters of several of the species of this area are unknown. The synopsis following is therefore quite imperfect, and founded largely on the extremely unsatisfactory features of coloration.

a. Small; mantle with a large submedian orifice; shell very convex, *nigrocincta.*

aa. Large or moderate sized; no large mantle-orifice so far as known,

b. Surface marked with ocellated spots,
lineolata, oculifera, argus.

bb. Not ocellate.

c. Mantle with a subcentral tube; swimming lobes ample.

d. Olive-brown with pale spots; mantle reddish,
maculata.

dd. Dark green, coarsely marbled with dark, and with many groups of pale dots, *tigrina.*

cc. Characters of mantle unknown, *tigrinella, nodifera.*

ccc. Mantle with a subcentral perforation; lobes ample; uniform dark green, *juliana.*

T. NIGROCINCTA Martens. Pl. 17, figs. 14, 15, 16.

Length, in spirit, 17 mill., alt. 11, breadth 7 mill. Smooth, light brown, the free margins of the swimming lobes, the edge of the sole, and the margin of the *rather large hole in the mantle,* black, mostly continuous, sometimes rather spotted.

Shell strongly convex, comparatively large, of a beautiful amber-yellow, shining reddish through the mantle; spoon-shaped, with shallow sinus and strongly incurved apex; 11½ mill. long, 8 wide, 5 high, occupying more than half the total length of the animal. (*Martens.*)

Fouquets, Mauritius (Möbius).

Aplysia nigrocincta MARTENS, in Möbius' Beitr. zur Meeresfauna der Insul Mauritius u. der Seychellen, p. 307, pl. 21, f. 3 (1880).

"Reminds one of *A. virescens* Risso, pl. 19, f. 5, of unknown locality, but coloration and form of the shell are different." This species is allied to *T. parvula, T. elongata,* etc., species with large mantle foramen and very convex shell.

T. MACULATA Rang. Pl. 60, figs. 49, 50, 51, 52.

Length 9 cm. Oblong, much swollen, depressed at the base, elongated in front and obtuse behind, smooth. Swimming lobes of moderate size, the dorsal cavity very open. Mantle reddish, with a long excurrent siphon and a tubular foramen. Gills roseate.

Color, externally, brown-olivaceous, with some pale spots, the dorsal cavity reddish.

Shell oval, very concave, membranous with very little calcareous substance; sinus small and nearly posterior; apex a little recurved

and thick. Color reddish outside and within. Length 16 mill. (*Rang.*)

Table Bay and Natal Coast, South Africa, on Fucus (Wahlberg); *Réunion* (Maillard).

Aplysia maculata Rang, Hist. Nat. Aplys., p. 58, pl. 12, f. 6–9.—Krauss, Die Südafrik. Moll., p. 71.—Desh., Moll. de l'Ile Réunion, p. 54.—Martens, in Möbius, Meeresfauna Maurit., etc., p. 307.—Sowb., Conch. Icon., f. 25 (false locality; figs. copied).—? *Aplysia spuria* Krauss, *l. c.*

The general form is about as usual, the back being swollen, both ends lengthened, the tail rounded instead of acute. The eyes are quite apparent. The shell is almost entirely corneous.

T. juliana Quoy & Gaimard. Pl. 17, figs. 9, 10.

Length 4 to 5 inches. Proportions normal, the foot moderately projecting behind, the sole bearing a rounded disk or escutcheon posteriorly. Tentacles unusually large, the labial lobes flattened. Swimming lobes ample. Mantle with a perforation.

Smooth, of a uniform dark green color.

Shell broad, oval, very membranous, the spire small.

Mauritius.

Aplysia juliana Q. & G., Voy. de l'Astrol. Zool., ii, p. 309, pl. 24, f. 5, 6.—Mart., in Möbius' Maurit., p. 307.—*A. julianna* Sowb., Conch. Icon., f. 20.—*A. julienna* Gray.

Described by Quoy & Gaimard from alcoholic specimens.

T. tigrina Rang. Pl. 16, figs. 3, 4; pl. 59, figs. 40, 41.

Length 15 cm. Much swollen, rather short, acute behind. Swimming lobes broad and quite long; mantle oblong, with a little conic tube; excurrent siphon moderately long. Surface smooth.

General color dark greenish, varied with markings of two kinds: a coarse marbling of a very deep tint over the whole body, the mantle and the inner surfaces of the swimming lobes; assuming on this last tract the appearance of a blackish net-work on a quite light ground; besides this there is a marking of very numerous small, pale, rounded spots, variously grouped, over the outer surface and in front of the mantle.

Shell ovate-oblong, membranaceous, with no distinct calcareous layer, somewhat concave, acute behind; the sinus quite wide and shallow. Color livid yellow outside. Length 33 mill.

Mauritius.

Aplysia tigrina Rang, Hist. Nat. Aplys., p. 57, pl. 11.—Desh., Moll. Réun., p. 54.—Mart., in Möbius, p. 307.

This is not the *A. tigrina* of Quoy & Gaimard, nor of Angas and Sowerby. I do not know whether it is that of Deshayes and von Martens or not.

T. tigrinella Gray. Pl. 16, figs. 5, 6.

Body elevated, greenish, very lucid, reticulated with brown, with scattered spots and little lines of black.

Because our individual, the drawing of which was made from the living animal, offers some differences from that of Rang, we include it here. Its length is six inches; back very much swollen. The swimming lobes smooth, always elevated, form a sinus extending from behind the tentacles nearly to the tail. The foot is narrow, the head short, and the tentacles are not much developed. The ground color is a clear, diaphanous green, reticulated with spots of bistre, in the midst of which are black dots or little lines. The head is more regularly reticulated.

The shell is broad, oval, a little concave, leathery, very finely striated, with the beginning of a spire; its edges are entirely membranous.

Port Louis, Mauritius.

Aplysia tigrina Quoy & Gaimard, Voy. de l'Astrol. Zool., ii, p. 308, pl. 24, f. 1, 2 (1832).—*A. tigrinella* Gray, Systematic arrangement of the Figures, in M. E. Gray's Figures of Molluscous Animals, iv, p. 97, No. 27 (1850); referring to Vol. i, pl. 61, f. 4, copies of Quoy's figures cited above.

My information and figures, like Gray's, are derived entirely from Quoy's account of this form. It differs strikingly from Rang's *A. tigrina* in the shell (compare pl. 16, figs. 4 and 6), and there are also differences in the soft parts. Quoy's figure from life shows short finger-like processes scattered over the outer surface of the swimming lobes, like a *Notarchus*, although his description mentions no such structure. The species appears, however, to be clearly distinct from *A. tigrina* Rang, and the name proposed by Gray is therefore adopted.

T. nodifera Adams & Reeve. Pl. 16, fig. 1.

Dull olivaceous, covered with numerous rather distant elevated tubercles; painted with pale violaceous sparse spots, the foot orna-

mented with brown spots, the edge surrounded with a series of white spots. (*A. & R.*).

Mauritius.

Aplysia nodifera A. & R., Zool. Voy. Samarang, p. 64, pl. 18, f. 7 (1848).

"The row of white spots round the margin and numerous pale violet spots on the sides are striking characters of this species." In this form, as in the other forms described by Adams, structural characters are ignored, although Rang in 1828 had indicated the more important features of the external anatomy of Aplysia.

T. LINEOLATA Adams & Reeve. Pl. 16, fig. 2.

Back convex, posteriorly acuminate; pale green, ornamented with blackish anastomosing lines and numerous eye-spots, with the pupil black, the iris vivid violaceous. This elegant species is remarkable for the acuminated form of its caudal extremity, and for the slenderness of the posterior tentacles. (*A. & R.*).

Mauritius.

Aplysia lineolata A. & R., Zool. Voy. H. M. S. Samarang, Moll., p. 63, pl. 17, f. 1 (1848).

No structural details have been published.

T. OCULIFERA Adams & Reeve. Pl. 16, fig. 8.

Dull green, ornamented with ocelli or eye-spots having the pupil buff, iris brown, and with buff and white dots arranged in groups. The beautiful eye-like spots render the appearance of this species very elegant. The posterior tentacles are subulate and acutely pointed. (*A. & R.*).

Mauritius.

Aplysia oculifera A. & R., Zool. Voy. Samarang, p. 64, pl. 17, f. 3 (1848).

"The *Aplysia punctata* of Philippi is marked with congregated dots in the same manner, but it wants the ocelli; the *Aplysia argus* of Rüppell has the body covered with numerous ocelli, without the clusters of dots."

T. ARGUS Rüppell & Leuckart. Pl. 60, fig. 53.

Length of living individuals 1 foot; an alcoholic specimen measures 5 inches. General form as in *A. depilans*. The forward tentacles are very broad and trumpet-shaped; the swimming lobes are

wide, folded together over the back, nearly covering the mantle cavity. Eyes near and in front of the tentacles, small and black, with encircling rings of blue. Olive colored, with scattered eye-like spots composed of a white center surrounded by a dark brown ring. Shell quite thin, transparent, light brown.

Near Tor, Red Sea, on sea-grass in March.

Aplysia argus R. & L., Atlas zu der Reise im nördlichen Afrika von Eduard Rüppell. Neue wirbellose Thiere des Rothen Meeres, p. 23, pl. 7, f. 1 (1828).—? *Aplysia radiata* EHRENBERG, Symb. Phys., Evert., Decas 1 (1831), not *A. radiata* Crouch.—? *Aplysia scutellata* EHRENB., *l. c.*

The illustration is drawn and colored from life. I consider *A. radiata* (name preoccupied) and *A. scutellata* as in all probability synonyms, but repeat below the essential characters described by Ehrenberg.

A. radiata Ehrenb. Length 3 inches; olive-green. Outer surface of swimming lobes and back with brown ocelli with radiating black lines; inner surface of swimming lobes with dull yellow spots surrounded with black-brown; labial tentacles scarcely auriculate; mantle ovate, lightly convex, emarginate behind, less than a third the total length.

Tor, Red Sea.

The color of the three specimens observed was the same, but they varied in size, the largest being 3 inches long. Body a soft green, subreticulated above with black-brown and black lines, which usually radiate from the ocelli, and on the neck are longer and longitudinal. Foot brownish-green with sparsely scattered black marks; labial tentacles not produced in hamate ears. This species is closely allied to *A. argus* Leuck., but that species has the labial tentacles larger, much dilated and hamate, the eyes encircled by blue rings, the inner surfaces of swimming lobes lacking dull yellow spots, the radiating lines less distinct, and the mantle proportionally longer.

A. scutellata Ehrenberg. Length 1½ inches. Dull green, similar to *A. radiata* in the fine striæ and black radiated ocelli, but the inner surface of swimming lobes is pale, clouded with green and brown, the tentacles slightly auriculate, and shell ovate, nearly half

the length of the animal, in an individual 18 lines long, the shell measures 8x6 lines. Penis stouter.

Differs from *A. radiata* mainly in the greater size of the shell compared to length of body. It is from the southern part of the Red Sea.

VIII. *Species of unknown locality.*

T. TRIGONA Sowerby. Pl. 20, fig. 42.

Shell small, horny, brown, subtrigonal, ventricose, apex rather straight, acuminately produced, upper margin straight, reflected, obtusely angular at the end; outer lip straight, obliquely produced before; dorsal margin obliquely sloped towards the lower margin, lower margin short. (*Sowb.*).

Habitat unknown.

A. trigona SOWB., Conch. Icon., pl. 4, f. 11 (Aug., 1869).

This species resembles *Aplysia punctata* in color, texture, and convexity, but differs from them in its triangular form.

T. ANGUILLA Cuming. Pl. 43, fig. 28.

Shell small, tumid, strongly arched, transverse, pale horn; apex rounded, small, incurved; upper margin very short, deeply excavated, acuminated at the end; outer lip obliquely produced; dorsal margin round; lower margin oblique, widely excavated. (*Sowb.*).

Habitat unknown.

A. anguilla Cuming *MS.*, SOWB., Conch. Icon., pl. 6, f. 22.

A species with very convex shell.

Unrecognized and spurious species.

Laplisia viridis Bosc, 1802, Hist. Nat. Vers, i, p. 64, pl. 2, f. 4 (see also Nouv. Dict. d'Hist. Nat., pl. 5, f. 23, and Rang, p. 73), described from the harbor of Charleston, S. C., belongs, in my opinion, to the nudibranch family *Elysiidæ*.

Aplysia sicula Swainson, Treatise on Malacology, or Shells and Shell-fish, p. 247, fig. 45, (1840). This Sicilian species drawn in outline from life, is entirely unrecognizable from Swainson's sketch, by which alone it is known.

Aplysia unicolor Risso, Journ. de Physique, etc., lxxxvii, p. 374.

Aplysia nigromarginata Risso, *t. c.*, p. 375, and Hist. Nat. Eur. Mérid., iv, p. 43.

Aplysia lutea Risso, J. Phys., p. 375, and Hist. Nat., p. 43.

All described from the vicinity of Nice, and none of them recognizable with certainty.

Aplysia unicolor Blainville, Dict. Sc. Nat., xxvi, p. 327 (1823); Journ. de Phys., Vol. 96, f. 9, 10. Bayonne, Toulon, Ocean coast of France. Not recognizably described.

Aplysia petersonii Gray. Body contracted posteriorly, and divided transversely into two portions. Head very large, depressed smooth. Foot very broad, deeply emarginate in front, expanded beyond the edge of the body; the part beneath the hinder portion of the body divided by deep wrinkles into distinct tubercles. Mouth sunk in, large; labial expansions short, triangular, wrinkled. Tentacula situated half way between the head and the transverse contraction, short, conical. Body subglobular, externally tubercular, wrinkled. Lobes of the mantle rounded, united behind, the right one rather longer than the left, partly covering the shield. Shield partly exposed, ovate; nucleus submedial; columellar edge subangularly bent. Length 5 inches, breadth 2½ inches. (*Gray.*)

This species constitutes a peculiar section of the genus, characterized by the transverse contraction of the body. The animal figured in Seba, iii, t. 1, f. 8, 9 (*Aplysia sebæ*, n.) appears to belong to the same section. It differs from the foregoing species in the form of the hinder part of the foot, etc. (*Gray* Spicilegia Zoologica, pt. I, p. 4, pl. 4, f. 4, 4a (one-half nat. size). July 1, 1828.)

Marseilles (Peterson esq.).

I am disposed to think this a peculiarly abnormal specimen of *Tethys leporina*. It was evidently described from an alcoholic example. Type said to be in Brit. Mus. Sowerby's later *A. petersoni* (see p. 70) is not the same.

Aplysia sebæ Gray, Spicil. Zool., p. 5; Seba, Locupletissimi Rerum Naturalium Thesauri, etc., iii, p. 4, pl. 1, f. 8, 9. Gray's information on this is contained in the last paragraph of his description of *A. petersoni* (see above). On referring to Seba's portly folio I am quite ready to endorse his opinion that the creature pictured is a very singular marine monster; but my Aplysia lore does not enable me to name it.

"*Aplysia lessoni* L. emend Gm." of Mazzarelli and Zuccardi, Boll. Soc. Nat. Napoli iii, 1889, p. 51, from coral reef at Honolulu, Hawaiian Is., can scarcely be the *A. lessoni* of Rang (see p. 86). Can the specimen possibly have exchanged locality labels with *A. chierchiana*, also collected by Chierchia, and described in the same paper?

Subgenus PHYCOPHILA A. Adams, 1861.

Phycophila AD., Annals and Magazine of Natural History (3), viii, p. 141 (August, 1861).—*Placobranchus* M. E. GRAY, Figs. Moll. Anim., iv, p. 35, 1850.—*Aclesia* (Pacobranchus) GRAY, *t. c.*, p. 98.

Body compressed, elongated; sole of foot narrow; shell elongated, oblong, thin, flat, membranous, the apex not involute. (*Ad.*). Type *A. euchlora.*

This group, as far as known, is mainly distinguished by its very much elongated tail, and the narrow sole adapted to creeping on floating weed away from the shore. Its true affinities and status cannot be determined from the meagre data now extant. Were it not for the membranous shell mentioned by Adams I would refer this group to *Stylocheilus.*

T. EUCHLORA A. Adams. Pl. 61, fig. 54.

Green, smooth, compressed; sole narrow; forward tentacles elongated, backward tentacles narrow, truncate at their apices; tail produced. Shell membranous, oblong, dilated in front, the apex not involute. (*Ad.*).

Strait of Tsugaru (*Tsugar or Tseuka*), *Japan*, crawling on floating Zostera (*Ad.*).

Aplysia (*Phycophila*) *euchlora* A. AD., Ann. Mag. Nat. Hist. (3), viii, August, 1861, p. 141.—*Placobranchus euchlorus* in M. E. Gray's Figures of Molluscous Animals, iv, p. 35 (name only); ii, pl. 179, f. 1, right hand fig. (1850).

Mrs. Gray's figure was etched from a drawing by Arthur Adams. She gives the locality "Borneo." "It is oceanic in its habits, or at least found at some distance from the shore."

T. ADAMSI Pilsbry, n. n. Pl. 61, fig. 55.

No description of this species has been published. It is known by a figure drawn from life by Arthur Adams. The very long tail,

variegated and ocellated color-pattern and short swimming lobes, indicate a distinct species, however.

Borneo.

Placobranchus ocellatus (Van Hasselt), M. E. Gray, Figs. Moll. Anim., 1850, iv, p. 35; ii, pl. 179, left hand figure (from Adams' drawing).—*Aplysia ocellata* A. Ad., Ann. Mag. N. H. (3), viii, p. 141 (August, 1861); name only. Not *Aplysia ocellata* d'Orbigny.

Genus II. PARAPLYSIA Pilsbry, 1895.

Paraplysia Pils., Man. Conch. XV, pt. 62, p. 64 (Nov. 26, 1895).

General form oval; buccal tentacles rather large, widely separated and pointed; rhinophores small, conic, close together, *situated between the anterior ends of pleuropodial lobes.* Pleuropodia arising at the anterior third of the animal's length, *well separated* at their origin and throughout, uniting only at their union with the foot very near its posterior extremity. Mantle large, *posterior*, exposed, with a posterior excurrent siphon, and apparently covering the gill; the genital pore slightly in front of its anterior edge, not covered.

Shell about a third the length of body, concave, subquadrate.

This very well characterized genus is known by Dr. Gilchrist's paper cited and quoted below. Unfortunately the presence and nature of the mantle foramen and the opaline gland are not stated; the dentition is unknown, and the shell has not been figured. The latter apparently resembles that of *Tethys.*

The remarkable features of this type are: the position—unique in the Anaspidea—of the rhinophores between the anterior ends of pleuropodial lobes, the latter being completely free; the posterior situation of the mantle, and the short, oval form of the body. The posterior end of foot is free from the visceral mass, which overhangs it.

P. piperata Smith. Pl. 21, fig. 12.

Animal (in spirit) olivaceous, minutely and closely dotted everywhere, with the exception of the foot, with black; hinder third part of the body somewhat paler than the rest, from which it is marked off by a blackish band passing right round the animal. Lobes of the mantle narrowish in front where they arise quite close to the posterior tentacles, considerably dilated behind. Oral tentacles large, long, and pointed; posterior small, close together, conical.

Shell white, concave within, subquadrate. Length 27 millim., width 22. Animal about 80 long. (*Smith*).

Thursday Island, Torres Straits, 4–5 fms., sandy bottom.

Aplysia piperata SMITH, Zool. Coll. Alert, p. 89.—GILCHRIST, Ann. Mag. N. H. (6), xv, 1895, p. 403, pl. 18, f. 2, 4.

Peculiar on account of the position of the posterior tentacles, close to the origin of the mantle-lobes. (*Smith*). The lighter posterior end and dark encircling band described by Mr. Smith are perhaps due to accidental causes, as another and better preserved specimen in the collection shows no traces of these. (*Gilchrist*).

P. MOUHOTI Gilchrist. Pl. 21, figs. 13, 14.

It closely resembles *A. piperata* in the general structure of the body and in coloring. It is, however, well differentiated from it: (1) by the absence of the prolongation of the mantle into a long excretory siphon posteriorly. (2) The pleuropodia also are somewhat less developed, lie closer to the body, and evidently do not function as swimming-organs—compare the plicated edge of the pleuropodia of fig. 12, with that of fig. 13. The difference between the pleuropodia in the two species is most marked at their anterior end. (3) The coloring differs somewhat, in *A. piperata* there is a uniform sprinkling of black dots all over the animal except on the sole of the foot and under the mantle, showing an inclination, especially on the head and mantle to run into small radiating lines. In *A. mouhoti* this speckling of dark spots is absent, and there is a tendency rather to reticulate marking on pleuropodia and linear marking on head and mantle. (*Gilchrist*).

Siam (Mouhot).

Aplysia mouhoti GILCHRIST, Annals and Mag. Nat. Hist. (6), xv, May, 1895, p. 404, pl. 18, f. 1, 3, 5.

The figures are natural size.

A species of this genus may perhaps be indicated by the etching of a Ceylonese Aplysia from a rude drawing by Templeton, in M. E. Gray's Figs. Moll. Anim., vol. iii, pl. 270, f. 4.

Subfamily DOLABRIFERINÆ Pilsbry.

Aplysiidæ in which the pleuropodial lobes are considerably united behind, and *their forward insertions contiguous*, parted only by the genital groove. *Genital opening in front of the gill;* shell calcareous

or absent; radula with *a well-developed median series of teeth*, larger than the lateral teeth, and bilobed, spreading, at base.

Four genera compose this subfamily, which is decidedly more allied to the *Aplysiinæ* than to the *Dolabellinæ*. The anterior insertions of the pleuropodia are contiguous, as in the latter group; but the dentition, and the forward situation of the genital orifice agree with *Aplysiinæ*.

Genus III. DOLABRIFERA Gray, 1847.

Dolabrifera Gray, P. Z. S., 1847, p. 162; type *Dolabella dolabrifera*.—*Aplysia* and *Dolabella* of some authors.—? *Thallepus* Swains., Malacol., p. 250, 359.—*Dolabrifer* Fischer, Man. Conchyl., p. 568.

General form ovate-oblong or sack-like, tapering toward the head. Tentacles and rhinophores slit and expanded distally, the latter nearer to the front margin than to the dorsal slit. Eyes as in *Tethys*. Pleuropodial lobes arising far behind the middle of length, contiguous, scarcely mobile, united behind, enclosing a large gill-cavity; dorsal slit short. Mantle small, not perforated over the shell, nor covering much of the gill. Foot broad, often expanded at the edges. Genital pore in front of the gill, under the mantle-edge.

Shell small, not spiral, solid and calcareous; subtriangular, trapezoidal or irregularly oblong; the apex projecting and calloused, with no spiral tendency.

Radula with large, subtriangular rhachidian teeth, with several denticles on the cusp; lateral teeth with long, coarsely denticulate cusps (see under *D. ascifera*).

Type, *D. dolabrifera* Cuvier.

Distribution, tropical shores in both hemispheres; one species from Greenland.

This genus is allied to *Petalifera* in external characters and the solid, calcareous shell; but it differs in having the mantle completely closed over the shell, while in *Petalifera* there is a large orifice exposing part of the shell. *Dolabella* resembles *Dolabrifera* in the form of the body, short posterior branchial slit, etc., but it differs radically in the dentition, the position of the female genital orifice, and the spiral apex of the shell.

A considerable number of species are known more or less perfectly from the Indo-Pacific area, with a few from tropical America.

The Greenland habitat assigned for *D. hollbölli* is extraordinary, if it be correct; no other species of *Aplysiidæ* being known from such high latitudes. The list of some eighteen species here following may be reduced by future investigation on the range of variation in the shells; but on the other hand the genus is one likely to be overlooked by shell hunters, so that the discovery of additional new forms may be anticipated.

Species of the Cape and Indian Ocean.

D. DOLABRIFERA Cuvier. Pl. 34, figs. 11, 12, 13, 16.

Length 90 mill. Elongated, very slender anteriorly, the tentacles slim; dorsal slit small, pleuropodial lobes very close. Greenish, spotted with black, especially below, and bristling with very acute projections; foot very wide.

Shell very solid, very narrow, lengthened, curved; very calcareous, the epidermis being excessively thin; form quadrangular, with the apex distinct and a little calloused; white, enamelled. Length 9 mill.

Island of Bourbon, on the slime under submerged stones, and in brackish ponds near the shore (Rang!).

Dolabella dolabrifera Cuvier, Regne Animal, (edit. 1) ii, p. 398, (name only!).—*Aplysia* (*Dolabella*) *dolabrifera* Cuv., Rang, Hist. Nat. Aplys., p. 51, pl. 4, f. 1–6.

When living the surface is seen to be covered with acute but soft spine-like projections. The shell varies considerable with age, yet it shows always, and perhaps more than in the other species of this section, a quadrangular form. A shell very different in form from the great majority of specimens was found in one individual collected by Rang (pl. 34, figs. 14, 15), but the soft parts were the same as usual, and it is regarded by Rang as abnormal.

D. CUVIERI H. & A. Adams. Pl. 34, fig. 28.

Soft parts unknown. Shell solid, squarish, impressed with two medial, indistinct, radiating canals; beak produced, trigonal, with thick, back-turned, square apex; external and terminal margins sinuated, end roundly acuminated. (*Sowb.*).

Island of Bourbon.

Dolabrifera cuvieri H. & A. Ad., Gen. Rec. Moll., ii, p. 33, pl. 59, fig. 4a (no description).—Sowb., C. Icon., xvi, f. 4, 4a.

D. cuvieri was originally proposed as a substitute for *D. dolabrifera* Cuv., evidently in order to avoid the duplication of names consequent upon the recognition of *Dolabrifera* as a genus. The type of *D. dolabrifera*, however, has a long shell (see pl. 34, figs. 12, 13), and the square one figured by Adams apparently is specifically distinct. Possibly the shell figured by Rang as a monster of *D. dolabrifera* is the same as H. & A. Adams' species.

D. MAILLARDI Deshayes. Pl. 34, figs. 26, 27.

Soft parts unknown. Shell small, calcareo-corneous, elongated, trigonal, a little arcuate longitudinally, terminating in a small callous posteriorly; left margin straight, right margin rounded, the *sinus long and straight*. Upper surface regularly concentrically striated, lower surface with a thin shining callus; color yellowish-white, corneous, semitransparent. Length 7, width 3 mill.

Island of Bourbon (Réunion).

D. maillardi DESH., Catal. Moll. Réunion, p. 53, pl. 7, f. 20–22 (1863).

D. TRIANGULARIS Watson. Pl. 65, figs. 7, 8.

Soft parts unknown. Shell much arched, corrugated, porcellanous, dull, and scored on the upper surface with sharp strong lines of growth, on the under surface lustrous and amorphous, with a strong but irregular oblique longitudinal furrow and rough radiating lines toward the back; it resembles the blade of a fleam, being triangular, with a straight back, the handle (where the nucleus is) in front, and the point (a bluntly rounded one) on the left. Round the nucleus there is an amorphous expansion and thickening; across the blade obscure and unequal rays diverge from a point behind the nucleus. The back of the blade is thick and blunt, the other two sides are bluntly beveled to a sharp edge. Length 0·43, width 0·21; height of arch 0·1, greatest breadth behind 0·3 inch. (*Watson*).

Simons Bay, Cape of Good Hope, 15–20 fms. (Challenger).

D. triangularis WATS., Journ. Linn. Soc. Lond., xvii, p. 346; Challenger Gastrop, p. 673, pl. 50, f. 7.

This species is much more attenuated in front than *Dolabrifera marmorea* Pease from the Sandwich Islands, which otherwise it much resembles in form and texture, whilst it is in sculpture much more delicate. *Dolabrifera maillardi* Deshayes from the Island of

Bourbon (see Moll. de Bourbon, p. 53, pl. VII, figs. 20–22), is much more regular in shape, more like the seed of our common plane (Acer pseudo-platanus), with a regular shaped wing and a head or nucleus continuous with the body instead of, as here, a fleam-like blade and distinct handle. (*Watson*).

Species of Australia and Polynesia.

D. BRAZIERI Sowerby.

Soft parts unknown. Shell straight, rather flat; apex elevated, straight, thick; rounded and convex within, concave outside; posterior margin sloping, concave; labial margin nearly straight, anteriorly incurved, sinuous; left margin nearly straight. (*Sowb.*).

Length ¾ inch. (*Angas*).

Northhead, Botany Bay, and "Bottle and Glass" rocks, Port Jackson, Australia (Brazier).

D. brazieri SOWB., P. Z. S., 1870, p. 250.—ANGAS, P. Z. S., 1871, p. 99; P. Z. S., 1877, p. 190.

Only two specimens of this, the first species of the genus found on the southwest coast of Australia, were taken by Mr. John Brazier. No note seems to have been taken of the characters of the animal, but the shell, which is large, differs from that of other known species. (*Sowb.*).

D. JACKSONIENSIS n. sp. Pl. 44, figs. 38, 39, 40, 41.

Alcoholic specimen, length 28, breadth 16, alt. 6 or 7 mill.; broad ovate, the head narrow, foot expanded and depressed toward the periphery; back moderately convex. Dorsal slit short (7 mill. long), the pleuropodial lobes contiguous in the middle, gaping buttonhole like behind, diverging in front, the anterior insertions rather separated. Tentacles and rhinophores as usual in the genus, trumpet-shaped. Eyes black, distinct. Integument light yellowish, blue-tinged over the viscera, wrinkled (from contraction) and bearing rather distant warts, some of which behind and at the sides are pointed. Mantle not perforated over the shell, not covering the gill. *Genital pore some distance anterior to the forward end of dorsal slit.*

Shell (pl. 44, fig. 40 outside, fig. 39 profile, fig. 38 inside view) thin, squarish below, the posterior half tapering; apex curved toward the sinus, very heavily calloused within. Sinus long, concave above,

straight below; left margin gently convex. Outside gently concave along the middle, sculptured with growth-striæ, white with some concentric bluish bands. Interior white, but slightly convex, scarcely calloused. Length 7, breadth 3·2 mill.

Port Jackson, New South Wales, Australia (Dr. J. C. Cox).

D. brazieri is described as "straight", "apex straight," words that in no way apply to the present form. Still, the two examples of this species which I possess are much smaller than *D. brazieri*, which has a shell nearly 19 mill. long. Further comparisons are necessary to determine fully the relationship existing between the two forms. A notable feature of *D. jacksoniensis* is the anterior position of the genital opening.

D. VITRÆA Sowerby. Pl. 34, figs. 23, 24.

Soft parts unknown. Shell small, thin, glassy, pellucid, narrow; rostrum short, rather wide, apex incurved, thick; basal margin slightly arched, outer margin a little rounded. (*Sowerby*).

"Narai," Fiji Islands.

D. vitræa SOWB., Conch. Icon., xvi, pl. 1, f. 1 (1868).

The smallest of the known species; it is thin and glassy.

D. TAHITENSIS Pease. Pl. 34, figs. 6, 7, 8.

Animal rather slender, elongate, pyriform, deepest and widest posteriorly, rounded behind, margins thin; back arched and furnished with scattered, minute, subretractile, simple and branched filaments; head rounded above, convex in front; eyes immersed, a little in advance of the dorsal tentacles, the pupil bluish-black and iris bluish-slate; dorsal tentacles strongly dilated outwards, ear-shaped, obliquely truncate and grooved; anterior pair of about the same size, rather more dilated. Variegated with different shades of white, green, olive-brown and sometimes blotched with rusty-brown; foot pale greenish-gray, closely and finely dotted with opaque white and olive. (*Pse.*).

Tahiti.

Dolabrifera tahitensis PSE., P. Z. S., 1861, p. 245; Amer. Journ. Conch., iv, p. 77, pl. 8, f. 5.

Common under stones in littoral zone. Active in its motions, gliding along by the middle and lateral portions of the foot alternately. The species approaches *D. olivacea* Pse., Sandwich Islands. (*Pse.*).

D. FUSCA Pease. Pl. 34, figs. 1, 2, 3, 4, 5.

Shell elongate, triangular, right side straight, left side slightly curved towards the apex, surface decussated with striæ, lower half grooved longitudinally in the middle; base roundly truncate; apex callous; whole shell slightly bent.

The shells of all the species I have seen, inhabiting Polynesia, are callous at the apex to secure the ligament which holds the shell. They also differ from those heretofore described, in being of a more triangular shape. The one herewith figured may be taken as the type of them all.

Animal oblong, pyriform, widest posteriorly, and gradually tapering in front. Surface smooth, margins thin and ruffled, rounded behind. Eyes immersed, a little anterior of the dorsal tentacles; tentacles openly convolute, dilated at their extremities and crenate. Color above uniform brown, right lobe, which covers the gills, margined with white; beneath pale bluish centrally, passing into pale brown, and closely freckled with darker brown and white. (*Pse.*).

Tahiti?

D. fusca PSE., Amer. Journ. Conch., iv, p. 76, 160, pl. 8, f. 4; pl. 12, f. 27. (Oct. 1, 1868.)

Station under stones, in the upper region of the laminarian zone. The peculiarity of this species is the character of its margin adapted for swimming. (*Pse.*).

D. PACIFICA Pease. Pl. 34, fig. 18.

Soft parts unknown. Shell thin, straight, oblong; beak wide, apex incurved, slightly thickened; basal margin elongated, rather straight; terminal margin roundly angular; outer margin subsinuous in the middle. (*Sowb.*).

Islands in the Pacific (Sowb.).

D. pacifica (Pease) SOWB., Conch. Icon., xvi, October, 1868, f. 3.

D. OAHOUENSIS Souleyet. Pl. 22, figs. 6, 7, 8, 9.

Length 7–8 cm. Body much swollen, elongated and contracted in front, visibly prolonged behind, but not terminating in a point. Surface smooth. Green, tinted with rose in some places, and marked throughout with small spots of very deep green, almost blackish. Pleuropodial lobes close on the back, leaving a very narrow fissure between them.

Shell calcareous, white, a little arcuate, wider and flat in front, contracted and callous at the posterior part.

Oahu, Sandwich Is. (Voy. Bonite).

Aplysia oahouensis SOUL., Voy. autour du Monde * * la Bonite, Zool., ii, p. 461, pl. 25, f. 10–13 (1852).

The description of this form has been overlooked by subsequent writers. Perhaps one or other of Pease's species will prove to be synonymous with it.

D. OLIVACEA Pease. Pl. 34, fig. 25.

Elongate pyriform shape, rounded posteriorly, rugose, and ornamented with small filaments. Back convexly rounded. Mantle lobes small, rounded and closely enveloping the body, the right overlapping the left, leaving two small orifices; a groove extends from the mantle lobes along the back and right side of the head to the mouth. Dorsal tentacles grooved laterally and slightly dilating outwards, oral tentacles longer than the dorsal, and curved forwards, grooved and much dilated. Eyes small, black, distinct, sessile in front, laterally to dorsal tentacles. Mouth with a bilobed veil. Foot smooth, shape same as body. Color varies; usually of a dark olive-green, with sap green margins, and varied with whitish and dusky. Filaments pale. Foot pale greenish-slate, dotted with dusky brown and white. (*Pease*).

Shell narrow, straight, oblong, radiately depressed in the middle. Margins straight, square; beak produced, trigonal; apex callous, bilobed. (*Sowb.*)

Sandwich Is. (Pse.)

D. olivacea PSE., P. Z. S., 1860, p. 22.—SOWB., Conch. Icon., xvi, pl. 1, f. 7.—*Aplysia* (*Dolabrifera*) *olivacea* MARTENS & LANGKAVEL, Donum Bismarckianum, p. 54.

The eggs are deposited under stones, coiled from right to left.

D. MARMOREA Pease. Pl. 34, figs. 21, 22.

Soft parts unknown. Shell short, subquadrate, thickened, straight; beak rather short, wide, thick, with incurved, callous apex; basal margin straight; upper margin excavated; external and terminal margins a little contracted. (*Sowb.*)

Sandwich Is.

D. marmorea (Pease) SOWB., C. Icon., xvi, f. 5.

Two specimens of the species here described are labelled as above in the late Cumingian collection. The name is probably derived from the coloring of the animal. (*Sowb.*)

Species of West America, West Indies and Greenland.

D. NICARAGUANA n. sp. Pl. 63, figs. 12, 13, 14, 15, 16.

Alcoholic specimens measure, (*a*) length 40, breadth 21, alt. 16 mill.; (*b*) length 41, breadth 19, alt. 14 mill. Body plump, gradually narrowed in front, broadly rounded behind; sole very broad. Surface smooth, or showing few scattered and minute teat-like warts on the back. Tentacles and rhinophores very short, funnel-shaped, but collapsed. Eyes, distinct black dots about midway between rhinophores and tentacles. Dorsal slit far behind the middle of body, and to the right, short, about one-fourth the length of body, gaping button-hole like at the two ends. Mantle small, imperforate, not covering all of the gill; the anus projecting as a large tube at its posterior end. Genital orifice at forward end of gill. Opaline gland opens to the left of the gill.

Color (in alcohol) a uniform dirty cream or yellowish tint throughout.

Shell solid, narrow, regularly tapering from the rounded anterior end to the obtuse apex, curved longitudinally, right margin convex, left margin more or less concave. *Outside concave*, arcuate-striate, partly covered with a brownish cuticle; *inside heavily calloused* and convex along the middle, white. Apex with an irregular callus. No sinus. Length 9½, breadth 3 mill.

San Juan del Sur, Nicaragua (Dr. J. F. Bransford!)

The shell is shaped somewhat as in *D. oahouensis*, but differs notably from all other known species. In one specimen it is more bent laterally (fig. 15).

This is the only species of the genus known from the west coast of the Americas.

D. ASCIFERA Rang. Pl. 34, figs. 19, 20, 29, 17; pl. 65, figs. 10, 11.

Animal 85 mill. long, of the same form as *C. dolabrifera*, but the back more rounded. Dorsal slit very small. Yellowish-brown, with small obtuse tubercles.

Shell more angular than *D. dolabrifera*, recurved, narrow, the apex much calloused, enamelled, thick and callous, especially in the middle. Length 9 mill.

Saint Jeanne de Cayenne (type locality; Richard); *St. Thomas, St. Croix* (Riise, Oersted, Krebs).

Aplysia (*Dolabella*) *ascifera* RANG, Hist. Nat. Aplys., p. 51, pl. 4, f. 7–9.—*Dolabrifera ascifera* MORCH, Mal. Bl., xxii, p. 176.—SOWB., Conch. Icon., xvi, pl. 1, f. 6a, 6b.—BERGH, Verh. k.-k. zool.-bot. Gesellsch. in Wien., xxii, 1872, p. 441, pl. 5, f. 25–29; pl. 6, f. 1–10 (anatomy).

Externally of the same form as *D. dolabrifera*, but the back is more rounded; but distinguished by the yellowish-brown color of the surface which is strewn with numerous obtuse projections, like little warts. The dorsal slit is very small, mantle a little larger than in *D. dolabrifera*. The shell also shows sufficiently recognizable differential characters, being wider in the middle, more angular, and especially thicker in the center, which is calloused and enamelled; the apex is more calloused and quite small. This shell is the most calcareous of the genus. It is perfectly white.

Figures 19, 20, 29 are from the original illustrations of Rang. Fig. 17 is a smaller shell copied from Sowerby. My description is from Rang.

The dentition has been worked out by Bergh from specimens collected by Riise. His figures are here reproduced. Pl. 65, figs. 10, 11, shell; pl. 67, fig. 25, median and first lateral teeth; fig. 21, laterals from inner fifth of a row, from the side; fig. 24, laterals of the following fifth, from above; fig. 22, laterals from the third fifth, viewed from the side; fig. 23, the outermost laterals.

D. SWIFTII n. sp. Pl. 67, figs. 19, 20.

Soft parts unknown. Shell trapezoidal with projecting beak, well curved, moderately solid, but not much calloused within; white with thin yellowish cuticle. *Sinus long, concave; left margin straight*; basal or anterior margin *truncated at a right angle with the left margin, and distinctly emarginate;* right margin below the sinus parallel with the left, but gently convex. Beak obtuse, with a flat, callous extension, roughened and thickened on the ventral side. Length 11, breadth 5½ mill.

West Indies (R. Swift).

The shell of this species somewhat resembles that of *D. fusca*, as figured by Pease, but the sinus is more equally concave, and the narrow extension of the beak longer.

D. SOWERBYI Guilding. Pl. 34, figs. 9, 10.

Soft parts unknown. Shell tortuous, subtrigonal, beak tortuous, thrown backwards, produced, apex small; basal margin rather straight, upper margin concave, external margin sinuated below the middle, roundly acuminated at the end; disk centrally depressed at the back. (*Sowb.*)

St. Vincent, West Indies.

Dolabrifera sowerbyi ("Guilding Zool. Journ." according to Sowerby, but not in the Zoological Journal), SOWB., Conch. Icon., xvi, pl. 1, f. 2.

The tortuous depression in the dorsal disk, and the acuminate termination of the outer margin distinguish this species. (*Sowb.*)

D. (?) ORNATA Swainson. *Unfigured.*

Swainson has given an imperfect description from an unpublished colored drawing by Guilding, of a species perhaps belonging to this genus. The locality is unknown, but probably St. Vincent, West Indies. As none of the important structural characters are known, the generic name will not stand, if the creature proves to belong to some known genus; but the species, on account of its brilliant coloring, will probably be recognized sooner or later. It is not known whether the drawing was enlarged or natural size, so the dimensions given may prove incorrect. Swainson's description here follows:

Thallepus ornatus. Body more slender and fusiform [than *Aplysia*]; the lobes of the mantle [pleuropodial lobes] short and incapable of being used for swimming; tentacula two, large, ear-shaped; eyes not visible; lower pair of tentacula wanting. A most beautiful figure of a species to which I give this name, is among Guilding's drawings, but without any description; it was evidently finished from the living animal. The general color is sea-green, covered with minute black and white dots. The edges or crests of the reflected mantle [pleuropodia] have a broad edging of the richest orange, bordered on their outer edge with a line of deep black; the tentacula are also orange, and formed like those of *Aplysia*. Total length about 3½ inches. The only memorandum on the drawing is "eyes not visible." Whether this had any covering over the branchia I have no means of judging (*Swains.*, Treatise on Malacology, or Shells and Shell-fish, pp. 250, 359. 1840).

This form may prove to be the same as one of the West Indian species known from the shell only.

D. HOLLBOLLI Bergh. Pl. 65, fig. 9; pl. 62, figs. 5, 6, 7, 8.

Dimensions of contracted specimen, length 25, breadth 22, alt. 16 mill. Body short and stout; back elevated, smooth above, the sides irregularly knotted by contraction. Gill slit weakly curved, gaping behind. Mantle of moderate breadth. Anus situated as usual, at the posterior end of mantle. Gill (fig. 5) dark gray-brownish, the right side most developed, each side having 5–6 larger branches. Foot extending somewhat behind body, and projecting in front in rounded lobes each side of the head (fig. 8). Sole rather large and wide. Color dark olive-brownish, darkest at the lateral margins and here and there on the sole; the sides of the upper surface having here and there scattered, dark, more red-brown irregular spots, about 2 mill. in diameter; and in a few places the same color occurs more diffused and also on the edges of the upper tentacles. The lens shows fine (gland-) openings all over the back. Anterior tentacles are like the rhinophores, but edges more reflexed, especially below where they overlap somewhat. Rhinophores short-pedicelled auriculate, somewhat funnel-shaped above, deeply cleft down the outer sides. Between the tentacles and rhinophores, but more separated, are the very distinct black eyes.

Shell extremely thin, membranous, weakly bent longitudinally and laterally, pale yellowish, with fine growth-striæ; long-trapezoidal, with nearly parallel lateral borders, the apex strongly projecting, anterior end quite straight. Length 10½, breadth 4⅓ mill. (fig. 9).

Teeth differing from those of *D. ascifera* in having the cusps of the laterals longer and slenderer (pl. 67, fig. 29, central tooth; fig. 28, 1st lateral; fig. 27, 30, two side teeth in profile).

Greenland (Hollböll).

D. hollbölli BERGH, Verh. k.-k. zool.-bot. Gesellsch. in Wien, xxii, 1872, p. 438, pl. 5, f. 1–24.

It is remarkable that a species of this tropical group should occur in Greenland seas. The longer shell with less excised sinus, and the longer and slenderer cusps of the lateral teeth are points of difference between this species and *D. ascifera*. But one specimen is known. Pl. 62, fig. 7, front view; fig. 6, side view; fig. 8, head from below.

Genus IV. PETALIFERA Gray, 1847.

Petalifera Gray, A List of the Genera of Recent Mollusca, their synonyma and types, in P. Z. S., 1847, p. 162, type *Aplysia petalifera.*—*Aplysiella* Fischer, Journ. de Conchyl., 1872, p. 296 (for *A. petalifera* and *unguifera*).—Vayssiere, Rech. Zool. et Anat. sur les Moll. Opistobr. du Golfe de Marseille, 1re Partie, Tectibranches, p. 71 (Ann. du Mus. d'Hist. Nat. de Marseille, Zool., ii). 1885.

Body long-ovate, moderately convex, with the neck and head short and ill-defined; eyes, anterior tentacles and rhinophores of the form usual in Aplysiidæ, the latter nearer to the anterior end than to the dorsal slit. Mouth with more or less developed lateral palpi. Pleuropodial lobes arising at or behind the middle of the length, contiguous, the right often overlapping the left, united behind, leaving a short gill-slit more or less open at the two ends; mantle thin, with a very large median orifice exposing the shell. Genital orifice within the slit, in front of mantle. Anus, genital groove, etc., as usual. Integument more or less warty in life. Foot very broad.

Shell thin, hyaline, slightly concave and squarish, the posterior sinus wide and concave.

Radula with the rhachidian tooth 5-denticulate, inner laterals with the cusp long, armed with 3 or 4 denticles on its outer edge; on the outer laterals these denticles increase in length, equalling or surpassing the main cusp (pl. 55, fig. 12, rhachidian, 1st and another lateral, 25th and 43d laterals).

Distribution: Mediterranean, Japan.

This genus differs from *Tethys* in the shortening and posterior union of the pleuropodial lobes, which no longer have the function of swimming organs; in the less covered shell, more anterior genital pore, and in the teeth, the cusps of which lack the fine serration seen in *Tethys*, and have no denticles on the inner sides of the laterals.

The section *Aplysia* of the genus *Tethys*, represented by *T. punctata, depilans*, etc., is somewhat allied to *Petalifera* in having a rather large mantle-orifice exposing the shell, and more or less broad union of the pleuropodia behind; but it differs widely in dentition, in the degree of development of the swimming-lobes and in numerous other features. *Petalifera* differs from *Dolabrifera* in the presence of a large orifice in the mantle exposing part of the shell.

The species live on Zostera and Algæ, to the fronds of which they strongly adhere by the broad sole. Locomotion is wholly by creeping.

The number of true species is extremely doubtful, most of those described being known by the imperfect original descriptions only. *A. virescens* alone, is well known by Vayssière's excellent work on the Tectibranchs of the Gulf of Marseilles.

The name *Petalifera* was proposed by Gray as a subdivision under *Dolabrifera*, in 1847; no diagnosis being given. Fischer proposed *Aplysiella* for the same species in 1872, likewise without characterization of the group.

Subdivisions.

Petalifera s. str. Shell squarish, with conspicuous posterior sinus; lateral teeth with long cusps.

Pseudaplysia Pils. Shell oblong-ovate with the sinus obsolete; lateral teeth with broad, blunt cusps.

P. VIRESCENS Risso. Pl. 36, figs. 9, 10; pl. 55, figs. 10, 11, 12.

Length 25 to 36 mill. Oval, narrower in front; surface roughened by low, tuberculous papillæ, and sub-epidermal calcareous granules under the light spots. Mantle less developed than in *Tethys*, consisting of a nearly hyaline membrane which covers only the borders of the shell, most of the dorsal surface of which is exposed through the large mantle-orifice. Pleuropodial lobes united behind, with thick edges along the short dorsal slit; foot broad and fleshy. Gill milk-white. Genital pore situated a little back of the anterior insertion of the pleuropodial lobes. Genital groove, anus, etc. as in *Aplysiidæ* generally.

General color above reddish-brown, or greenish-brown with large light spots; lower surface pale grayish, with only traces of brown spots, but with numerous whitish spots due to calcareous particles sunken in the tissues. After death the body is a more or less strong tint of greenish-yellow.

Shell squarish, the beak projecting; sinus deeply concave and wide.

Nice (Risso, Robb & v. Beneden); *Gulf of Marseilles* (Vayssière); *lives on floating fucus throughout the Mediterranean* (Monts.).

Aplysia virescente Risso, Hist. Nat. Eur. Mérid., p. 42; *A. virescens* t. c., p. 433, pl. 1, f. 10 (1826).—*Aplysia petalifera* Rang, Hist. Nat. Aplys., p. 52, pl. 5, f. 1–3 (1828).—*Aplysia unguifera* Rang, ibid., pl. 5, f. 4–7.—*Aplysiella petalifera* and *unguifera* Fischer,

Journ. de Conchyl., 1872, p. 296.—*Aplysia webbii* Van beneden & Robb, Mag. de Zoologie, 1836, cl. v, p. 3, pl. 77, f. 3*a.-b.*—Van beneden, Ann. Sci. Nat., iv, 1835, p. 251.—*Aplysiella webbii* Monts., Journ. de Conchyl., 1877, p. 47.—*A. webi* Locard, Ann. de l'Agric. Lyon, 1885, p. 68.—*Aplysiella weebbii* Vayssiere, Rech. Moll. Opistobr., p. 71, pl. 3, f. 70–76 (dentition, etc.).—*Aplysia quadrata* Sowerby, Genera of Shells, fig. 4; Conch. Icon., f. 37a, b.—? *A. similis* Sowb., C. Icon., f. 38*a, b.* (1869).

The relations borne by this species to *brugnatellii*, *ornata*, and especially *depressa*, are much in need of elucidation. There cannot be much doubt that *A. quadrata* (pl. 55, figs. 13, 14) is the shell of this species, and I am disposed to believe that *A. similis* (pl. 19, figs. 32, 33) is the same, though Sowerby says that it is "more obliquely oval, more laterally curved, and less quadrate than *A. quadrata*."

P. ferussacii Rang. Pl. 55, figs. 7, 8, 9.

Length 35 mill. Oblong, much swollen and short behind, lengthened in front; swimming lobes elevated, especially behind, narrow. Mantle oblong, with a very large orifice; foot narrow.

Color livid brown, variegated with large and very irregular black spots.

Shell nearly round, pale and diaphanous, resembling a thin film; the sinus is almost wanting, apex very small. Length 8 mill.

Habitat unknown.

A. ferussacii Rang, Hist. Nat. Aplys., p. 66, pl. 19, f. 6–9 (1828).

Described from Férussac's collection. The species has not been recognized by later authors.

P. brugnatellii Vanbeneden & Robb. Pl. 36, figs. 11, 12.

Length 35 mill. Body elongate, widened, swollen in the middle, tapering towards the ends. Foot strongly depressed and rounded posteriorly; pleuropodial lobes small, separated, showing the greater part of the mantle. The integument around the mouth is prolonged in two appendages. Tentacles, genital openings, etc., as in the genus.

Pale, dappled with irregular orange spots, border of mantle purple; rhinophores colorless. Sole colorless and diaphanous, showing by transparence the viscera, which are a handsome blue.

Shell thin and transparent, with well-marked but irregular growth striæ. It is not enclosed by the mantle, and seems to be attached by the beak only.

Nice (collected in September).

Aplysia brugnatellii Vanb. & Robb, Guerin's Mag. de Zool., 1836, classe v, pl. 77, f. 1, 2, p. 1; Ann. Sci. Nat., 1835, p. 251.

The species most approaching *A. brugnatellii* is the *A. ferussacii* of Rang. It is distinguished from that by the depressed, rounded tail, and the coloring, dappled with orange dots, *ferussacii* being spotted with black.

It is notable that this species has buccal appendages such as Fischer describes for his *Phyllaplysia lafonti.*

P. ornata Deshayes. Pl. 36, fig. 3.

Length 35 mill. Dark green above, ornamented with numerous oval yellow spots; rhinophores flesh colored, spotless; anterior tentacles spotted like the body.

Algerian coast.

Dolabella ornata Desh., Traite Elementaire de Conchyl., ii, p. 57, atlas, pl. 89, f. 5.—Fredol, Le Monde de la Mér. pl. 11, f. 10.—*Phyllaplysia ornata* Fischer, Journ. de Conchyl., 1872, p. 297.

This form is known by Deshayes figure only, no description having been published. It may prove to be a synonym of *A. brugnatellii*; indeed I have very little doubt that they are identical.

Section Pseudaplysia Pilsbry, 1896.

External features as in *Petalifera;* labial palpi developed. Shell ovate claw-shaped, with the sinus obsolete; rhachidian tooth five-denticulate, inner lateral with trilobate, the rest with broad bilobate cusps.

Differs from *Phyllaplysia* in the five-lobed, instead of three-lobed median tooth of the radula, and the presence of a well-developed shell. From *Petalifera* it differs in the form of the lateral teeth and the oblong shell without a posterior sinus.

P. punctulata Tapparone-Canefri. Pl. 36, figs. 4, 5, 6, 7.

Length 17–25 mill., width 6–6½ mill. Body flattened, narrow, much lengthened, somewhat narrowed behind. Head and neck short, anterior tentacles hollow, their bases rather distant, apices

truncated; rhinophores tubular, slightly expanded toward their apices, slit below. Foot rather broad, truncated in front, scarcely differentiated from the integument of upper surface. Gill cavity small, enclosed by two minute lobes; mouth longitudinal, furnished with two transverse, fleshy lateral processes (pl. 36, fig. 4).

General ground-color not known, markings consisting of minute irregular dots most numerous above.

Shell (pl. 36, fig. 5) small, claw-shaped, long, thin, glassy and pellucid, with iridescent reflections, sculptured with concentric growth lines, the nucleus apical, sinus obsolete.

Radula (pl. 36, fig. 6) seems to have teeth according to the formula 30·1·30. See above for description of teeth.

Yokohama, Japan.

Phyllaplysia punctulata T.-C., Zool. del Viaggio intorno al Globo della R. Fregata Magenta, Malacologia, p. 112, pl. 2, f. 3 *a*, *b*, *c* (1874).

Genus V. PHYLLAPLYSIA Fischer, 1872.

Phyllaplysia Fischer, Journ. de Conch., 1872, p. 297.—Mazzarelli, Boll. Soc. di Naturalisti in Napoli, vii, 1893, p. 5, pl. I (anatomy).

Body oblong-oval, much depressed and flattened; eyes, anterior tentacles and rhinophores as usual in the family, the latter much nearer the anterior end than to the dorsal slit. Mouth with well-developed labial palpi. Pleuropodial lobes arising behind the middle of the length, contiguous, the right overlying the left, united behind, leaving a very short dorsal slit more or less open at the two ends. Foot very broad.

Shell wanting. Opaline gland diffuse.

Radula (pl. 9, fig. 26) with the rhachidian tooth tricuspid, cusps acute; inner laterals with three broad, obtuse cusps, the middle one largest; passing outward on the radula the inner cusp increases in size, and the outer cusp decreases and becomes obsolete. Mazzarelli gives a somewhat different form of teeth (pl. 67, fig. 26).

Distribution: Bassin d'Arcachon, southwestern France.

Allied to *Petalifera* and especially to *Notarchus*, but the body is more depressed, the shell wanting, if we may trust Fischer's account, and the number of denticles of the teeth is less, the cusps of the

laterals broad and blunt. The position of the genital pore is not given by Fischer.

In habits *Phyllaplysia* is like *Petalifera* and *Notarchus*, living on Zostera and other sea-weeds upon which they feed, clinging with limpet-like tenacity to the supporting surface, and mating reciprocally like the land snails.

P. LAFONTI Fischer. Pl. 36, figs. 1, 2; pl. 9, fig. 26.

Length 15–35 mill. Body very much flattened, rounded in front, obtuse behind; head and neck short. Anterior tentacles wide, flattened, confluent at base, hollow, slit in front, truncated at the apices; rhinophores hollow, dilated at the ends, slit; the eyes in front of them. Branchial slit small, covered by small lobes; foot very wide, subtruncate in front; buccal processes conic and transverse.

Color pale green above, ornamented with concentric zones of a darker green, and small scattered spots formed of a rounded white dot surrounded by violaceous punctation, these spots appearing also on the anterior tentacles and becoming tubercular there; upper tentacles pale green, with 4 or 5 rings of pale violet. Foot very light greenish-white; buccal processes white and transparent.

Shell wanting.

Basin of Arcachon, s. w. France, on sea-weeds.

Dolabrifera lafonti Fischer, Ann. Sc. Nat. (5), xiii, 1870, p. 3 (no description).—*Phyllaplysia lafonti* FISCHER, Journal de Conchyl., 1872, p. 297, pl. 15, f. 1–3; Actes Soc. Linn. Bord., xxix, 1873, p. 236.—CROSSE, Journ. de Conch., 1875, p. 101.

This species lives on Zostera, which it resembles in color. They adhere strongly by the large foot, and crawl rapidly like Limaces; sometimes they float foot upward at the surface, in the manner of Limnæidæ. They cannot, of course, swim like Aplysias. Copulation is reciprocal, as in the Helices, two individuals placing themselves side by side, the head of one toward the tail of the other. They have been found only in the locality named and during the month of September.

Crosse collected a specimen 35 mill. long, 9 broad, in which the concentric zones and the spots were less conspicuous than in the types, the general color being a more vivid green. The animal, as observed by him in an aquarium, is habitually longer than shown in Fischer's figure, especially when in motion. The dorsal bands are more numerous and less distinctly concentric than shown in the

figure, and sometimes they are interrupted. Examined with a glass of strong magnification, they are seen to be composed of a multitude of tiny blackish and brown specks. The spots on the front tentacles are smaller and more numerous than the illustration shows, and, moreover, are projecting, forming little warts.

P. (?) DEPRESSA Cantraine. Pl. 36, figs. 13, 14.

Length 21 lines. Body long-ovate, subdepressed; green-buff, variegated with black; the sole wide, marginated, green marked with numerous oval gray spots.

This species is distinguished by the depressed form, the wide, margined foot, the nearly square head, distinct from the trunk and carried on a very short neck. The pleuropodial lobes are very small. There are four tentacles, the front pair are larger, depressed and truncate at the ends; the hind pair are nearly cylindrical, slit as usual. The sides and back are greenish yellow finely vermiculate with black; buccal region and ends of the anterior tentacles yellow; posterior tentacles (rhinophores) the color of the body. The coloration of the foot is remarkable; the ground color of clear green is varied by numerous oval, gray spots.

Ragusa Vecchia, Dalmatia.

Aplysia depressa CANTRAINE, Bull. Soc. Roy. Brux., ii, p. 385, Malacologie Méditerranéanne et Littorale, p. 71, pl. 3, f. 1.

Nothing is said by Cantraine of a shell. The single specimen is in the Royal Museum of Leyden. Fischer places this species in his genus *Phyllaplysia*. Compare the *Petalifera* species.

P. (?) LIMACINA Blainville. Pl. 43, figs. 32, 33.

Length 35 mill. Animal limaciform, oblong, obtuse in front, acute behind; flat and depressed all around the base. Integument smooth and of an obscure greenish color. Dorsal opening narrow in front, gaping behind. The foot is very wide.

Coast of Provence.

Aplysia limacina BLAINVILLE, Journ. de Phys., xcvi, 1823, p. 287, f. 10; Dict. Sc. Nat., xxvi, p. 328 (word Lièvre marin); Rang, Hist. Nat. Aplys., p. 72, pl. 22, f. 6, 7. Not *Tethys limacina* Linné, *Aplysia limacina* auct.

The tentacles offer no peculiar features; the integument is very smooth, and of a greenish-dusky color. Dorsal opening quite long, no appearance of a mantle being visible within it. The broad foot

and distinct depression of the peripheral region of the body, together with the lack of a shell, seem to indicate that this little-known form belongs to Fischer's genus *Phyllaplysia*. It has not been noticed by authors subsequent to Rang. There is no conflict between the name of this species and Linné's *Tethys limacina*; the latter was not referred to *Aplysia* until long after the date of de Blainville's description.

Genus VI. NOTARCHUS Cuvier, 1817.

Notarchus Cuv., Règne Animal, ii, p. 398.—*Bursatella* Blainv. (? Brit. Encycl. Suppl.), Fér., Dict. Class. Hist. Nat., ii, p. 588 (1822).—*Aclesia* Rang, Hist Nat Aplys., p. 68 (1828).—*Stylocheilus* Gld., U. S. Expl. Exped., p. 224 (1852).

General form long ovate or fusiform, plump in the middle. Tentacles, rhinophores, eyes and genital groove as usual in the family. Pleuropodial lobes broadly united behind over a large gill-cavity, their anterior ends contiguous, free margins short, contiguous; the dorsal slit subcentral and short. Mantle membranous, small, not covering the long, arcuate gill. Genital pore near anterior end of dorsal slit. Foot narrower than the body, long, acute behind.

Shell very minute and orbicular, or wanting.

Radula wide (pl. 40, f. 6), with well developed triangular rhachidian teeth with serrate cusp; the laterals narrower, with the cusp long and serrate on both edges (pl. 40, fig. 7). Marginals with the basal plates shorter, cusps longer (pl. 40, figs. 5, 8). Jaws wide, composed of many minute chitinous elements (pl. 40, fig. 9).

Type *N. indicus* Schweigger.

This genus differs from *Phyllaplysia* in the plump, elevated body and narrow sole; from all other genera it differs in the minute or obsolete shell.

Subdivisions.

No subdivisions of much value have yet been defined in this genus. The following sections are generally recognized, but their differential characters are unimportant.

a. Plump; sole a narrow band; integument tuberculate or smooth; labial processes not developed (?) *Notarchus.*

aa. Integument with filaments or fringed appendages; labial processes developed

b. Fusiform, the two ends attenuated, *Stylocheilus.*

bb. Stouter, foot wider, labial processes broad *Aclesia.*

Section *Notarchus* Cuv., *s. str.*

In the typical species of *Notarchus* the body is very plump and not excessively elongated or slender at the two ends; there are no distinct labial processes; the sole is extremely narrow; and the integument bears conic warts, often more or less branching, but not forming long, finely cut arborescent processes as in *Aclesia*. The typical forms are *N. indicus* and *N. punctatus*. Some other small species with lengthened extremities and smoother integument, such as *N. nudatus* and *N. citrinus* probably belong here also; while *N. ocellatus* and *N. polyomma* are still very imperfectly known.

N. INDICUS Schweigger. Pl. 40, figs. 14, 15, 16; pl. 61, figs. 56, 57, 58.

Length 3–4½, breadth 2, alt. 2·3 cm. Head about one-third as wide as body. Anterior tentacles stumpy, auriculate; rhinophores somewhat longer, excavated and auriculate; mouth a longitudinal slit; eyes placed laterally before the rhinophores. Foot obtuse in front, with two lobes, generally running out acutely. Sole with a median longitudinal furrow. Body as if inflated, having the dorsal opening somewhat in front of the middle, the pleuropodial lobes capable of being overlapped across it; when separated widely they raise up like a lid (fig. 14). Through this opening water is drawn to the gills, and rhythmically (every 5 seconds) expelled again. The conic elevations on the back and sides can be depressed. Color transparent yellowish-white, marbled and punctate with brownish-yellow or yellowish-brown. Many specimens are greenish-gray with olive-green flecks. Sole bluish, without markings. Entire upper surface punctate with white, most densely so on the conic protuberances, which are clear yellow in many specimens. (*Mts.*).

Mauritius, in about 2 metres.

Notarchus . . . . . CUVIER, Regne Anim. ii, 1817, p. 398, pl. 11, f. 1.—*N. indicus* SCHWEIGGER, Handbuch der Naturgeschichte der skelettlosen ungegliederten Thiere, 1820, p. 745 (based solely on Cuvier's work cited above).—MARTENS in Möbius' Beitr. zur Meeresfauna Maurit., p. 307, pl. 21, f. 4.—*N. cuvieri* BLAINV., Dict. Sc. Nat., xxxv, p. 161; Man. de Malacol., p. 473, pl. 43, f. 7 (1825).—*Aplysia gelatinosa* RANG, Hist. Nat. Aplys., p. 70, pl. 23, f. 1–5.—QUOY & GAIM., Zool. Astrol., p. 312, pl. 24, f. 3, 4.—DESH., Traite Elem. Conchyl., pl. 92, f. 8–10.

The figures of Cuvier, Rang and Möbius correspond moderately well. Rang's (pl. 61, figs. 56, 57, 58,) were drawn from specimens which had been in alcohol. The figures given by Quoy and Gaimard (pl 17, figs. 12, 13) represent the living animal; but are so different from the others as to excite suspicion that a distinct species may be represented. Whether this diversity is wholly due to the fresh or alcoholic condition of the specimens figured cannot readily be decided.

N. PUNCTATUS Philippi. Pl. 40, figs. 1–13.

Length 8–4·5 cm. or less. Animal oblong, swollen and much dilated at the sides, acute behind (figs. 1, 3, 12, 13). Head globose, on a rather short neck. Anterior tentacles cylindric-conic, open above, the margins rolled together below, continuous with the frontal veil (fig. 4, head seen from beneath). Rhinophores shaped like the tentacles, but open behind; the eyes sunken in the integument a little in front of the bases of the rhinophores. Surface of body bearing numerous somewhat dendritic or branching conic tubercles, irregularly scattered. Foot forming a smooth, quite narrow band, acute behind. Penis having a number of chitinous spurs distributed over its surface (fig. 11).

Color in life a yellow-fawn tint, with irregular spots of deeper color and a minute white punctation. Alcoholic specimens retain quite well the general tint, but the tissues lose their transparence.

Shell (fig. 10, magnified 25 diameters) minute, diam. 2 mill., very fragile, hyaline, placed under the mantle behind the anus, of the form of that of *Coriocella*.

Mediterranean: Gulf of Marseilles, 15–25 metres, on Zostera (Vayssière); *Palermo* (Philippi, Monterosato); *Nice* (Verany).

Notarchus punctatus PHIL., Enumeratio Molluscorum Siciliæ, 1836, p. [255], pl. 7, f. 9.—VAYSSIERE, Journal de Conchyl., 1882, p. 271, pl. 11, f. 8; Recherches Zool. et Anat. sur les Moll. Opistobranches du Golfe de Marseille, p. 77, pl. 3, f. 77–85; pl. 4, f. 86–95 (shell, anatomy).

This Mediterranean species is now well known by the work of Vayssière. The larger tubercles of the surface are arranged in a median series behind the gill slit, and two irregular rows on each side. The presence of a minute vestigial shell was first demonstrated by Vayssière.

N. LEACHII Blainville. Pl. 61, fig. 59.

Nearly the size of a fist. Body nearly globular, the foot being an oval area with projecting borders. Dorsal opening ovate, with thick borders, nearly symmetrical. Tentacles 4, slit; 2 buccal appendages; a tentacular organ in the middle of the head; no trace of a shell. Color yellowish-white, rather translucent, the whole upper surface bearing small tentacular appendages, irregularly placed.

Seas of India (Brit. Mus.).

Bursatella leachii BLAINV. (? Brit. Encyclop. Suppl., Art. Mollusca), Manuel de Malacol., p. 473, pl. 43, f. 6.—F (ERUSSAC), Dict. Classique d'Hist. Nat. ii, p. 588 (1822).—RANG, Hist. Nat. Aplys. p. 78.

This form seems to be allied to *N. indicus*, but is larger, and the head and tentacles are filamentous as in *Aclesia*. It is known only by Blainville's description and illustration, the latter representing a badly preserved specimen with the gill pulled out of the branchial cavity. Compare *N. gelatinosa* Q & G.

N. OCELLATUS Férussac. Pl. 41, figs. 17, 18, 19.

The mollusk for which this name was proposed is known only by a very handsome drawing by Van Hasselt, communicated to Férussac by Temminck. No description is extant, but its form and the general disposition of the external parts indicate that the animal is a *Notarchus*. The general contour is sufficiently shown by the figures. Color a beautiful yellow, with a horse-shoe shaped series of ocelli on the back, each with a blue center and orange ring. They apparently encircle the dorsal slit, which was not seen by Van Hasselt, probably on account of the small size of the animal. Length 4½ mill.

Java (?)

Aplysia ocellata Fér., RANG, Hist. Nat. Aplys., p. 74, pl. 24, f. 2–4.

N. NUDATUS Rang. Pl. 29, figs. 45, 46.

Length 36 mill. Animal much dilated and ventricose, lengthened and narrowed at the two ends. Integument smooth, dusky-greenish, with some scattered pale dots. Dorsal opening quite long, narrow, but gaping posteriorly. Foot narrow. (*Rang*).

Near the Sandwich Islands, on floating Fucus. (Quoy & Gaimard).

Especially marked by the much swollen form, the narrow portions front and rear being of about equal length. Head small; tentacles as usual. The integument is perfectly smooth, transparent, with some white dots around the dorsal aperture.

N. CITRINUS Rang. Pl. 29, fig. 40.

Lenth 25 mill. or smaller. Animal much dilated in the middle of the back, narrowed and acute at the two extremities. Integument a little translucent, yellow, with small white spots and very minute asperities. Dorsal aperture very small, narrow and a little oblique. Foot very narrow (*Rang*).

Mid-Atlantic, equatorial, on floating masses of Fucus. (Rang).

Aplysia citrina RANG, Hist. Nat. Aplys., p. 71, pl. 22, f. 1, 2.

The partial transparence of the integument allows some of the viscera to be seen. A liquor of the same color as the animal is produced.

N. POLYOMMA Mörch. *Unfigured.*

Length of dead animal 17 mill. Body long-fusiform, pale green, ornamented with close obscure longitudinal lines, and numerous approximated scarlet ocelli, four forming a necklace; digitated or papillar appendages. Tentacles 4, subequal, slit in front; eyes between them. Sole of the foot contracted in front, the forward margin semilunar, acute behind. Mouth cordiform (*Mörch*, description from a drawing).

Alcoholic specimens: Length 11 mill. Body warty, the epipodial lobes rounded, anal tube distinct, prolonged. Penis arcuate-conic, acute, tentacle-like, situated between the right eye and right anterior tentacle. Oral tentacles very short, obtuse, compressed and perpendicular; posterior tentacles longer, truncate; anterior shorter, somewhat acute. Seminal groove with a cord, passing obliquely downward to the base of the penis. Branchial plume falciform. Color pale yellowish with close longitudinal dusky lines, often confluent (*Mörch*).

St. Croix, West Indies (Riise).

Notarchus polyomma MORCH, Journ. de Conchyl. (3), iii, 1863, p. 25; Malak. Bl. xxii, p. 176.

Section *Stylocheilus* Gould, 1852.

Stylocheilus GLD., U. S. Expl. Exped., xii, Moll., p. 224.

Body limaciform, dilated at the sides and delicately attenuated posteriorly, cirrigerous; head separated from the body by a dis-

tinct neck, and furnished with four elongated, linear, distant tentacles, more or less ornamented with papillæ, mouth beneath, the lip dilated laterally into an acutely conical process, like a third pair of tentacles. (*Gld.*)

The papillæ on the mantle are capable of being individually elongated and contracted, as they are in Cypræa.

Distribution, Indo-Pacific region. These animals live on floating sea-weed, away from the shore. The exact status of the group, and its relation to *Notarchus* and *Aclesia*, can be ascertained only by more exact investigation of material. I have seen none of the species.

Most described forms are decorated with ocelli or eye-spots, and all but *N. longicauda* have simple or branching processes of the integument. In alcoholic specimens the lip-processes characteristic of the group are sometimes retracted; but they are never so strongly developed as in *Aclesia*.

N. LINEOLATUS Gould. Pl. 29, figs. 37, 38, 39.

Length three and a half inches. Animal elongated, delicately attenuated posteriorly, of a pale grass green color, ornamented with longitudinal, parallel, contorted, rusty lines, and scattered ocelli of unequal size. The papillæ of the mantle are branching. The anterior tentacles are short, tapering, and destitute of papillæ. (*Gld.*).

Honolulu, Oahu, on a coral reef.

Stylocheilus lineolatus GLD., U. S. Expl. Exped., Moll., p. 225, pl. 16, f. 270, *a* (1852); Otia Conch., p. 227.

Dr. Pickering, who observed this animal, remarks that the creeping disk is very long, ending in a sharp point. Branchial cavity generally kept pretty wide open; the branchiæ are very large, not covered by a dorsal plate, and colored above in the same manner as the mantle, and they are inflated as though injected with water. The heart is seen beating on the left side, immediately under the origin of the branchiæ. The vent projects much as in *Doris*. The lines on the surface were more or less concentric, like the striæ in the palms of the hands. Motion quite active.

Though the two figures differ somewhat in their details, I judge them to represent the same species. In the dark green one, the tentacles are shorter, and the cephalic pair are destitute of papillæ, and the papillæ are branched. In the pale one (fig. 37), the ten-

tacles are longer, more linear, all furnished with papillæ which are everywhere aculeate. But when we consider the identity of locality, the difficulty of delineating these animals while living, and their power of contracting and modifying parts, I think we may safely and properly regard them as the same. *Aplysia striata* Quoy, is lineated like this, but has naked truncated tentacles, and very few cirri. (*Gld.*).

N. STRIATUS Quoy & Gaimard. Pl. 29, figs. 47, 48, 49 (enlarged).

Length about 1 inch. Region of the pleuropodial lobes much swollen, rounded; the rest of the body elongated, especially the foot, which is very acuminate behind, rounded in front, and well separated from the buccal disk. The four appendages are large and long. The integument is raised in small simple fleshy cirri, those on the margins of pleuropodial lobes having several branches. Ground-color a perceptibly greenish-yellow; very finely striate with reddish brown parallel lines. These recurve sometimes, forming concentric circles. Besides these, the whole body is covered with very small yellowish lunules, with sky-blue dots in the middle. Two of these spots occupy the base of the labial tentacles and in front of the eyes. The foot is striated on the sole, like the rest of the body.

Near Port Dorey, New Guinea, on floating Fucus (Astrolabe); *Fouquets, Mauritius* (Möbius).

Aplysia striata Q. & G., Zool. Astrolabe, ii, p. 315, pl. 24, f. 9–11. —*Aclesia striata* MARTENS in Möbius' Beitr. zur Meeresfauna Mauritius, p. 308.

Möbius thus describes the Mauritius form, which is considered by Martens to be this species: Length when crawling 30–50 mill., breadth 7–8 mill. Greenish-gray, with white pointed warts. Black flecks and separated blue ones surrounded by a brown ring. These become distinct only under the microscope. Anus tubular, at back part of the gill orifice. The excrement contained shells of foraminifera.

N. CIRROSUS Stimpson.

Length 3 inches. Oblong, back rounded; foot short and pointed behind, somewhat acuminate; body covered with numerous rather long appendages, much ramified on the back, but mostly simple on the head and tentacula; dorsal tentacula short, tapering, with the upper half slit; orals large. Color bluish-grey, sprinkled with black

dots; the appendages edged with sulphur yellow; a few clear green circular spots in different parts of the body (*Stimp.*, Proc. Acad. Nat. Sci. Phila., vii, 1855, p. 378).

China (N. P. Ex. Exp.).

N. STIMPSONI Pilsbry, *n. n.*

Length 2 inches. Oblong-ovate, rather produced before, short and pointed behind; a few small, scattered, ramose appendages on the back and sides; color greenish, with minute, crowded, longitudinal black lines; a few small round nucleated spots on the sides; tentacles slender, the dorsal ones very long; eyes conspicuous, situated at a considerable distance in front of the dorsal tentacles. (*N. lineolatus* Stimp., Proc. Acad. Nat. Sci. Phila., vii, 1855, p. 378).

Loo Choo Is. (N. P. Ex. Exp.).

This species bore the same specific name as one previously defined by Gould, and apparently belongs to the same genus.

N. CIRRHIFER Quoy & Gaimard. Pl. 17, fig. 11.

Quite a large species (length 3 inches), with elevated back and long neck, having the lips extended, buccal appendages broad, and tentacles very long. The contracted foot is rounded in front, prolonged to a point behind. Entire body and tentacles covered with slender ramifying processes. The integument is somewhat diaphanous, of a grayish tint, with plaques of light brown in the center of which are emerald dots, but some are circles of reddish. The processes are generally parchment-white to yellowish. The gill may project to the exterior and form a semicircle on the right side. It is composed of a dozen main branches, of a greenish color striated with brown. The penis is large, very long, marked with white dots at the base. (*Q. & G.*).

Length 10, breadth 3, alt. 3 cm. Gray-green with brown punctulation; the back, sides and head with light blue dots, each surrounded by a yellow ring; many of these peacock-eye spots are encircled by brown lines. The entire integument is beset with conic papillæ; the larger papillæ of the back bear smaller papillæ. Tentacles with long papillæ. Sole narrow. Gill gray-green with brown striæ. (*Mobius*).

Mauritius (Astrolabe; Möbius).

Aplysia cirrhifera Q. & G., Zool. Astrol., ii, p. 311, pl. 24, f. 8.—*Aclesia cirrifera* MARTENS, in Möbius' Beitr. zur Meeresfauna Mauritius, p. 308.

In breathing, the mantle cavity is very forcibly expanded and contracted. The snail emits an intensely cobalt-blue liquor, part of which sinks to the bottom, staining the white coral-sand blue; the rest dispersing in the water. (*Mobius*).

N. QUERCINUS Gould. Pl. 29, fig. 44.

Length 3½ inches. Body limaciform, elongated, delicately attenuated; the ground color slaty, tinted with wood-color, and longitudinally grained with numerous unequal, rusty lines or folds. Tentacles very long, linear, truncate at tip, and beset with numerous acute papillæ. The papillæ on the body are long and branching but becoming more and more simple towards the margin and tail. Eyes distinct, in front of the cervical tentacles. (*Gld.*).

Levuka, Fiji Is.

Stylocheilus quercinus GLD., U. S. Expl. Exped., Moll., p. 226, pl. 16, f. 271 (1852); Otia Conch., p. 227.

The peculiar coloration and graining of this animal are something like that of oak wood.

N. RUFUS Quoy & Gaimard. Pl. 16, fig. 7.

This very small species has the body and neck elongated, as well as the four tentacles; the foot is quite short. The back appears elevated by the dilation of the borders of the pleuropodial lobes. All of these parts are villose and of a reddish brown color, with the appearance of longitudinal striæ. The integument is largely spotted with an almost black brown, fading to smoky in front. Genital furrow black, and a similar line is on the opposite side. Sole of the foot is a very light red-brown.

Road of Umata, Island of Guam, in 14 fms. (Astrolabe).

Aplysia rufa Q. & G., Zool. Astrol., ii, p. 314, pl. 24, f. 7.

The long, filament-like tentacles render it likely that this species is a *Stylocheilus;* but no labial processes are mentioned by Quoy.

N. LONGICAUDA Quoy & Gaimard. Pl. 29, figs. 41, 42, 43.

Length 63 mill. Animal swollen, full and oval, the anterior portion elongated, head small; the posterior lengthened and acute. Integument green, with spots of varied red and blue. Dorsal opening small, a little posterior, and oblique. Foot very narrow (*Rang*).

Near New Guinea, on free-floating Fucus.

A. longicauda Q. & G., Voy. Uranie, ii, p. 421, pl. 66, f. 8.—RANG, Hist. Nat. Aplys., p. 73, pl. 22, f. 8–10.

? *Aplysia brongniartii* BLAINV., Man. de Malacol., p. 472 (insufficient description).

In this species the neck is quite long, the tentacles pointed; tail extremely long. The general color, in life, is a pleasing green, sprinkled with dots of red surrounded with a circle of sky blue, and here and there some other whitish and blue spots. Rang could not see the labial tentacles in the preserved examples, but the naturalists of the *Uranie* affirmed their presence in the living animal.

Section *Aclesia* Rang, 1828.

Aclesia RANG, Hist. Nat. Aplys., p. 68.

Body plump, long oval, with moderately stout, short neck and head and short conic tail. Sole rather broad. Integument of the whole upper surface bearing numerous digitate or branched appendages with simple ones among them. Lateral labial processes broad and well developed.

Type *A. savignana.*

Allied to the restricted subgenus *Notarchus* in the plump form, but differing in the strongly developed labial processes, wider sole and elaborately fringed appendages of the integument. There is a certain indistinct arrangement of the larger appendages of the integument into about three longitudinal rows on each side of the dorsal slit. In *Stylocheilus* the fore and hind parts of the body are more attenuated and longer; but it is rather doubtful whether Gould's group will eventually be held separable from *Aclesia.*

The species are illustrated on plates 41, 42, 43 and 44.

Distribution, tropical and southern temperate seas.

Indo-Pacific: *N. savignanus, laciniatus,* Red Sea, Cape.
N. glaucus, New Zealand.
N. areola, Sandwich Is.

West Indian: *N. pleii, lacinulatus.*

N. SAVIGNANUS Audouin. Pl. 42, figs. 23–26.

Length 13 cm. Very plump, with the tail attenuated and acuminate, neck rather thick. Tentacles and rhinophores very short, tufted by numerous slender processes; a similar tuft in the middle of the head above, and others distributed at somewhat regular in-

tervals over the whole integument of the body. Smaller simple filaments are sparsely scattered among the tufts, and a fringe of short processes borders the rather broad sole on each side. Mouth longitudinal with wide wrinkled lips. Labial processes well developed. Color greenish-gray.

Egyptian coast of Red Sea (Savigny); *Natal* (Krauss).

. . . . . SAVIGNY, Descript. de l'Egypte, Gasterop., pl. II, f. 2.—*Bursatella savignana* AUDOUIN, Explic. somm. des planches de moll. de l'Egypte, p. 16.—*Aplysia savignana* Fér., RANG, Hist. Nat. Aplys., p. 69.—*A.* (*Aclésie*) *savignana* Fér., RANG, pl. 20.—*Notarchus* (*?*) *savignyanus* Aud., ISSEL, Mal. Mar Rosso, p. 165.—*Aplysia* (*Notarchus*) *savignana* Fér., KRAUSS, Die Südafrik. Moll., p. 72.

Natal specimens observed by Krauss are more thickly covered with processes and have longer tentacles. Specimens preserved in alcohol are brownish-black, very soft, elongated, swollen in the middle, slender and truncate in front, ending in a point behind. The foot is pretty wide, smooth, and above, like the rest of the upper surface, beset with long, soft, frequently divided threads, and here and again with appendages band-like at base, tattered above. The dorsal orifice lies more anterior than posterior, is long-oval, open, and about one-fourth the length of the animal, the margin a little reflexed. The anterior tentacles stand laterally and close behind the mouth, and each filamentiferous tentacle has a simple tapering process of half the size before, and united with it only at the base, so that it looks as if the anterior pair consisted of four tentacles. The posterior tentacles stand upon the neck, are shorter than the anterior, and filament-bearing.

N. LACINIATUS Rüppell & Leuckart. Pl. 41, figs. 20, 21, 22.

Length 4–5 inches; in alcohol, about 2 inches. Tentacles slit and ragged. Similarly ragged are about a score of the processes of the back; among these are simple string-like short compressed filaments. The two labial processes are simple, broad and attenuated forwardly (fig. 20). Mouth longitudinal, with the lips on each side finely wrinkled (fig. 20). Genital orifices and furrow as usual. Gill transversely placed, mainly free. To the left and forward in gill cavity an elevation caused by the opaline gland is seen, but no opening could be found. It emits a violet liquor. Anus surrounded by a ring of several (9) small papillæ (fig. 22). Gill slit about 1 inch long, capable of being entirely closed. Eyes not noticeable.

The body-color is gray yellowish; at the bases of the processes there are spots, part simple, part ocellated, the former dark brown; the small ocelli are formed of a white center surrounded by small closely placed or confluent dark brown flecks.

Near Tor, Red Sea, found in April in small families, or thrown on the beach. (Rüppell).

Notarchus laciniatus Rupp. & Leuck., Atlas zu der Reise im Nördlichen Afrika von Eduard Rüppell, Neue Wirbellose Thiere des rothen Meers, p. 24, pl. 7, f. 2, a, b, c (1828).—Issel, Mal. Mar Rosso, p. 165.

This species seems most nearly allied to *N. lacinulatus* Couthouy. Guppy (Proc. Sci. Asso. Trinidad, ii, p. 137; Proc. Vict. Inst. Trin., 1894, p. 123), reports it from the Gulf of Paria; but in my opinion his identification is incorrect. This is, perhaps, the most extravagantly ragged species of the group.

N. glaucus Cheeseman. Pl. 43, fig. 34.

Body from 3 to 5 inches long, about ovate when at rest, but capable of considerable extension, a little contracted behind the head, then elevated, and suddenly sloping to a point posteriorly; entirely covered with numerous simple and branched tentacle-like processes, the largest of which are sometimes eight lines long. Color of the sides pale grayish-brown, passing on the back into a dull sea-green; the whole surface with numerous irregularly shaped black blotches that are longest on the back. Along the back there is also a double row of from 8 to 12 emerald-green specks, each surrounded with a zone of umber. Dorsal tentacles ¾ inch long, folded down the outer side so as to appear tubular, beset with filiform appendages. Labial tentacles similar in shape, but rather larger. Branchial cavity large, protected by the folded-in edges of the mantle, branchiæ quite internal; foot long and narrowed, pointed behind, without side-lobes as in Aplysia, sole pale sea-green; mouth roundish, placed under the head; odontophore with very numerous rows of simple hooked teeth; gizzard strengthened with large triangular calcareous plates; shell none. (*Cheesem.*)

Auckland Harbor, New Zealand, rather sandy localities near the extreme verge of low-water mark.

Aclesia glauca Cheeseman, P. Z. S., 1878, p. 277, pl. 15, f. 4.—Hutton, Man. N. Z. Moll., p. 123.

Like many of the species of the allied genus *Aplysia*, this animal possesses the power of emitting a purple fluid from the edges of the mantle, but only in small quantity; and it may often be handled without anything of the kind being observed.

N. AREOLA Pease. *Unfigured.*

Length 2 inches. Elongate, smooth, rounded above, rather compressed on the sides, and everywhere covered with small branchial filaments. Mantle lobes elevated, short, rounded, and a groove extending from where they unite anteriorly on the back along the right side of the head to the mouth. Dorsal tentacles elongate and grooved laterally. Oral tentacles similar, but slightly dilated. Eyes a little in advance and slightly lateral to the base of the dorsal tentacles. Branchiæ large exposed or covered by the lobes of the mantle. Siphonal tube posterior and tubular. Foot narrow, elongated and projecting far beyond the lobes of the mantle in a point. Color cinereous or greenish-ash, densely and minutely veined longitudinally, and minutely speckled and clouded with white. Remote ocellations with blue centers and brown rings on a fawn ground, and scattering simple brown spots. (*Pse.*).

Sandwich Is., gregarious among seaweed (Pse.).

Aclesia areola PSE., P. Z. S., 1860, p. 24.

N. LACINULATUS Couthouy. Pl. 43, figs. 29, 30.

Length 2½ inches. Color pale green, closely covered with black dots, which give it a bronze hue, whole body ornamented with little green arborescent or frondescent tufts, irregularly disposed, except around the upper margin of the foot, where they are smaller and form a regular row; viewed in the water, these tufted appendages cause the animal to appear as if covered with a delicate moss. The mouth is nearly concealed by its thick fleshy lips, which are prolonged on each side into a slender tentaculiform process. Foot large and broad, sole yellow, dotted greenish. Twice as long as broad, elevated, abruptly sloping behind, the foot trailing in a point behind. (*Couth.*).

Harbor of Rio Janeiro, Brazil.

Bursatella lacinulata Couthouy MS., GOULD, U. S. Expl. Exped., Moll., p. 223, pl. 16, figs. 269, 269*a*.—*Notarchus lacinulatus* MORCH, Malak. Bl., xxii, p. 176.—? *Notarchus laciniatus* Rüpp., GUPPY, First sketch of a marine invertebrate fauna of the Gulf of Paria and its neighborhood, in Proc. Sci. Asso. Trinidad, 1877, ii, p. 137;

and Proc. Vict. Inst. Trin., 1895, p. 123. Not of Rüppell and Leuckart.

A single specimen found among rocks terminating the beach in front of the lagoon of Peteninga, one of those brackish lakes common along the coast separated from the sea by a strip of sand, perhaps fifty yards wide, and six feet above high tide. Resembles *A. savigniana* Fér., but is distinguished by its broader foot and the filamentous prolongation of the lips, as well as in many of its details. It belongs to the genus *Notarchus* of Cuvier. (*Gld.*).

N. PLEII Rang. Pl. 43, fig. 31 ; pl. 44, figs. 35, 36, 37 ; pl. 62, figs. 1, 2, 4 (anatomy).

Description of alcoholic specimens: Length about 11–13 cm. Long ovate, plump, very soft and flabby. Tentacles flattened, slit in front, bearing long filaments. Rhinophores rather short and with a few filaments. Entire dorsal surface having scattered minute simple filaments, and a number of larger, flattened processes, ragged with filaments. Sole broad, acute behind, roundly truncate in front, with a second free border behind the anterior margin. Mouth longitudinal with radially wrinkled lips ; lateral labial processes large, broad and flat. Color light olive.

Antilles (Plée) ; *St. Croix and St. Thomas* (Riise, Krebs, Ravn) ; *Little Gasparilla Bay, W. Florida* (Willcox & Heilprin), on floating masses of sea-weed.

Aplysia pleii RANG, Hist. Nat. Aplys., p. 70, pl. 21 (1828).—*Notarchus pleii* MORCH, Journ. de Conch., xi, 1863, p. 25 ; Malak. Bl., xxii, p. 176.—D'ORBIGNY, Moll. Cuba, i, p. 118.—ARANGO, Fauna Mal. Cubana, p. 156.

N. pleii is nearly allied to *N. lacinulatus*, but the latter is smaller, with more acuminate labial processes, according to the figures.

There is great variation in the degree of development of the appendages of the integument, some specimens having them less conspicuous than in Rang's figure (copied on pl. 43, fig. 31), while in others, such as the specimen from west Florida drawn in figs. 35, 36, of pl. 44, the appendages are longer. Rang's figure seems misleading in the drawing of the labial processes, according to my specimens, and he does not show the doubling of the anterior foot margin, conspicuous in all of the numerous examples I have seen.

Pl. 43, fig. 31 and pl. 44, fig. 37, are copied from Rang. I have drawn on pl. 44, fig. 35 (dorsal view) and fig. 36 (under side of

head and margin of sole) a specimen from Little Gasparilla Bay. Some others from the same locality have less developed appendages.

N. INTRAPICTUS Cockerell. *Unfigured.*

Length about 4¼ inches. Body swollen, subglobose; foot flattened, posteriorly broad, terminally acute. Neck subcylindrical, moderately thick. Anterior pair of tentacles large, branched, antler-like, retractile. Posterior pair large, cylindrical, somewhat tapering, hollow, with open truncate ends, and with two whorls of spine-like, soft, lateral branches; these and the other tentacle-like processes on the body are also retractile. On the middle line of the neck, between the pairs of tentacles, is a short but broad branched filament. Epipodia contiguous in the middle line, but with the anterior and posterior parts separating alternately, forming wide cavities, in respiration. The anterior of these cavities serves for inspiration, the posterior for expiration, and the whole respiratory cycle takes about five seconds. Quite a jet of water can be thrown from the posterior orifice. Sides of epipodia and body with many branched processes, some short, others long, the largest resembling the anterior cephalic tentacles. On the sides of the epipodia are three longitudinal series of these processes—one dorsal, one sub-dorsal, one lateral or sub-pedal. Each row numbers four processes, and the rows are so placed that, as a general rule, the processes of the dorsal row are more posterior than the equivalent ones of the lateral row. Sides of foot with many processes.

Color, prettily marbled with black and pale gray, dorsal portions of epipodia and sides of neck with most black. Most of the tentacles or processes tinged reddish, the larger ones mottled with white. Inside of epipodia gray with white dots. Sole finely speckled all over grey and white. (*Ckll.*).

Kingston, Jamaica.

Aclesia intrapicta CKLL., Ann. Mag. Nat. Hist. (6), xi, March, 1893, p. 219.

Described from a living specimen.

The anatomy, so far as I examined, agrees in all important points with that of *Aplysia*. The narrow white fore-gut enlarges rapidly to form the big gizzard, which is pale red in color. In this gizzard I found four (and a fifth rudimentary) little bodies, more or less triangular in outline, about 5 millim. diam., color pale yellowish-

brown. These, like those described by Prof. Ray Lankester in *Aplysia*, are, no doubt, for crushing the food. Posteriorly to the gizzard the gut is gray and rather broad, winding around the large brown liver. The genitalia are somewhat ordinary, but rather curious for their bright color, which suggests the specific name I have adopted. The albuminiparous gland and hermaphrodite duct are pale ochreous yellow, as is usual, but the gland has on one surface a large elongated patch of bright red, which does not remain well in alcohol. The ovotestis is large and irregularly globular, yellow-green in color, with two blackish broad sulci. A strong ligament has its origin on the ovotestis, close to the beginning of the hermaphrodite duct.

Subfamily DOLABELLINÆ Pilsbry.

Aplysiidæ in which the pleuropodial lobes are scarcely mobile, or separable, united behind enclosing a large gill chamber; their forward insertions contiguous, parted by the genital groove only; the dorsal slit short. Genital orifice under the posterior part of gill. Radula with the rhachidian tooth reduced to a narrow, cuspless vestige, side teeth excessively numerous, narrow, with long simple cusps.

Shell well-developed, calcareous, and posterior area of body defined by a groove and ridge in *Dolabella*, the only genus known.

This subfamily stands conspicuously apart from other *Aplysiidæ* in the posterior position of the genital foramen, and the peculiar dentition.

A group of teeth from the median part of the radula of *D. californica* Stearns is drawn in fig. 17 of pl. 67, showing two rhachidian with several adjacent lateral teeth. The cusps of the laterals become longer further from the middle of the radula, as in fig. 18, profile view of a lateral from middle of one side. On the outer edges of the membrane the teeth are smaller, but of the same form.

The place-relations of pleuropodial lobes, gill, genital pore, etc., are shown in the diagram, pl. 66, fig. 14 (*D. californica*).

Genus VII. DOLABELLA Lamarck, 1801.

Dolabella LAM., Syst. Anim. sans Vert., p. 62 (1801) type *D. callosa* Lam.=*scapula* Mart.—*Aplysia* RANG, *et al.*

General form conic, wide behind, narrower in front. Integument more or less warty. Head bearing in front a pair of subcylindric

buccal tentacles slit above; rhinophores or tentacles much nearer to the anterior margin than to the dorsal slit, similar to those of *Tethys*. Eyes minute, in front of rhinophores; posterior area of body defined by an obliquely transverse groove and ridge. Pleuropodial lobes united except for a dorsal slit, more open at the ends, the anterior insertions of lobes contiguous, parted only by the genital groove. Mantle not nearly covering the gill, produced in a folded siphon behind. Gill-cavity very large. Genital orifice under the posterior part of gill, penis very long, near right buccal-tentacle. Opaline gland multiple.

Shell solid and calcareous, hatchet-shaped, loosely coiled, the free spire obliquely decurved, heavily calloused; sinus deep and concave; margins reflexed.

Type *D. scapula* Martyn.

Distribution, tropical and subtropical Indo-Pacific and Australian seas, and west coast of Mexico.

Dolabella, while resembling *Tethys* in general appearance, differs from that genus in several important respects. The epipodial lobes are united behind and shortened in front, and their anterior ends are contiguous (see pl. 66, fig. 14, dotted lines); the posterior part of the body is marked off by a transverse ridge or frill; the common female orifice and vas deferens (pl. 66, fig. 14, *g. p.*) is situated far backward under the hind part of the gill (fig. 14, *G.*); and corresponding to this removal of the genital pore, the penis is greatly lengthened. The shell is mainly calcareous, and has the spire free and heavily calloused.

The distribution of the genus is restricted compared with *Tethys*, the Atlantic Ocean and communicating seas being without representatives; but the individual species seem to be more widely diffused than in the other genus. Extreme points in the known distribution of the group are the Red Sea and Cape on the west, west coast of Mexico, Sandwich and Viti Is. on the east; and southward, New South Wales is the limit.

The species need revision further than that here attempted, as there are several named forms of rather doubtful status. The shells, with one or two notable exceptions, furnish only differential characters of indifferent value.

Synopsis of Species.

a. Shell large, broad, with a saucer-like appendage above, *gigas.*

aa. Shell narrow, arched, the length about twice the width, [*elongata.*

aaa. Shell wider, irregularly triangular, the spire calloused.

b. Integument of body bearing conspicuous tubercles or foliations; posterior area with fringed boundary.

c. Conspicuously spotted or blotched, *teremidi, hasseltii.*

cc. Uniform or nearly uniform green, *scapula.*

bb. Integument smoothish or somewhat warty; boundary of posterior area simple, *ecaudata; californica.*

(*D. hemprichii* and *D. guayaquilensis* are omitted from the above table).

D. GIGAS Rang. Pl. 65, figs. 4, 5, 6.

Length as much as 30 cm. Violet and gray, with conic simple warts rounded at their summits.

Shell large and solid; convex, but with a wide curved depression near each edge outside; *very pale buff* outside, porcelain-white within; shining and sculptured with *strong concentric wrinkles* on both sides; sinus narrow and deeply curved, its edge broadly flaring backward, and with an extremely narrow reflexed margin. Spire well curved inward, with a rounded lump of callus at the apex within. Upper curve of the spire bearing *a very large, thin, erect, saucer-shaped accessory callous plate.* Cuticle broadly reflexed across the back of the spire, and continued in a wide, tapering reflexed border down the convex margin of shell. Length 80, breadth 55 mill.

Réunion (Desh.); *Mauritius* (Lienard, Möbius); *Red Sea* (Cuming).

Aplysia gigas RANG, Hist. Nat. Aplys., p. 48, pl. 3, f. 4.—*Dolabella gigas* SOWB., Conch. Icon., xvi, pl. 1, f. 1a, b.—MART. in Möbius' Mauritius, p. 306.—DESH., Moll. Réun., p. 53.

This is the largest species of the genus, and is very readily distinguished from all others by the broad saucer-like accessory plate arising from the upper margin. The soft parts are known from specimens collected by Möbius, and briefly described by von Martens, but not yet figured.

D. SCAPULA Martyn. Pl. 26, figs. 26, 27, 28; pl. 27, figs. 29, 30.

Length 30 to 38 cm. Much swollen posteriorly, tapering forward. Dorsal slit rather short, submedian, commencing forward of

the middle of the animal's length, its borders contiguous, not capable of being much separated. Posterior disk round, large, bounded by a conspicuously fringed ridge. Entire surface of body bristling with acute more or less elongated processes.

Color, dark or bright-green.

Shell solid, loosely coiled, covered outside with a strong yellow or yellow and brown cuticle; sculptured with irregular, wavy wrinkles of growth. Spire very heavily calloused above and at the inside edges; sinus very deep and very concave; margin of growth very convex, especially below; back with a broad reflexed border along the left margin, a narrow border along the edge of the sinus. Length 50, breadth 40 mill.

Amboyna (Martyn); *Moluccas* (Rumph.); *Timor* (Peron); *Waigiou and Rawak, and Islet of Pangai-Modou, Tongatabu* (Quoy & Gaim.); *Paramatta River* (Angas), *Port Jackson and Bellenger River* (Brazier), *E. Australia; Dungeness and Darnley Is., Torres Straits; Low I., Trinity Bay and Home Is., N.-E. Australia* (Brazier); *Mauritius* (Peron, Q. & G., Ad., *et al.*); *Réunion* (Desh.); *Seychelles and Amirante Is.* (Dufo); *Natal* (Krauss).

Patella scapula Martyn, Univ. Conch., iii, pl. 99 (17); Chenu's reprint Bibliothèque Conchyliogique (1), ii, p. 26, pl. 34, f. 3.—*Dolabella scapula* Angas, P. Z. S. 1867, p. 227.—? *Doris verrucosa* Gmel., Syst. Nat. (13), p. 3103 (1788).—Barbut, The Genera Vermium, pl. 4, f. 1.—*Dolabella callosa* Lam., Syst. An. s. Vert. (1801), p. 62 (founded on Rumphius, Mus., pl. 40, f. 12).—*Dolabella* . . . . . Cuvier, Ann. du Mus. d'Hist. Nat., v, p. 437, pl. 29, f. 1–3 (1804).—*D. rumphii* Cuv., Regne Anim., ii, p. 398, pl. 34, f. 1.—Lam., An. s. Vert. vi, (2me pt.), p. 41 (1822); and edit. Desh., vii, p. 699 (1836).—Adams & Reeve, Zool. Samarang, Moll., p. 65, pl. 18, f. 4.—Martens in Möbius' Beitr. zur Meeresfauna Maurit., p. 306.—Krauss, Die Südafrik. Moll., p. 72.—Smith, Zool. coll. H. M. S. Alert, p. 89.—Brazier, Proc. Linn. Soc. N. S. W., ii, p. 88.—*Aplysia rumphii* Rang, Hist. Nat. Aplys., p. 46, pl. 1.—Quoy & Gaimard, Voy. de l'Astrol., Zool., ii, p. 303, pl. 23, f. 4, 5.—*Dolabella peronii* Blainv., Dict. Sci. Nat., xiii, p. 395 (1819); Manuel de Malacol., p. 473.

Allied to *D. hasseltii*, but the dorsal slit is more anterior and the color nearly uniform. It seems to be very widely distributed over the Indo-Pacific life-area. It is eaten in Amboyna.

It is extremely doubtful whether *Doris verrucosa* Gmel. was based on this species; a reference to Rumphius inclines me to think it was a warty rather than filamentous species. The figure in Rumphius does not represent it.

D. TEREMIDI Rang. Pl. 63, figs. 9, 10, 11.

Length 13·1 cm. Very wide posteriorly, narrowed in front; dorsal slit more anterior than in most species, its margins thin, more easily separated; tentacles arising close to each other. Surface bristling with moderately long pointed tubercular processes; ridge bounding the large posterior disk somewhat fringed; excurrent siphon quite long.

Greenish, spotted with black, fawn and white, the white spots forming circles more or less complete; mantle sky blue; gills a delicate rose color.

Shell resembling that of *D. rumphii*, but more lengthened and narrower, the cuticle thicker and browner. Length 51 mill.

Tahiti and Borabora, Society Is.; Ualan, Caroline Is. (Lesson & Garnot); *Réunion* (Desh.); *San Giacinto, Philippines*, (Chierchia).

Aplysia teremidi Rang, Hist. Nat. Aplys., p. 48, pl. 3, f. 1–3.—*Dolabella teremidi* Lesson, Voy. autour du Monde La Coquille, Zool., ii, pt. 1, p. 293.—Desh., Moll. de l'Ile Réunion, p. 53.—Maz. & Zucc., Boll. Soc. Nat. Napoli, iii, 1889, p. 49.—*D. temnida* Gray, Figs. Moll. Anim., iv, p. 97.—*Térémidi*, Borabora Islanders' vernacular.

This species is evidently most nearly allied to *D. hasseltii;* but apparently is smaller, with more anterior dorsal slit, and comparatively larger shell. It is used for food by the natives of the Society Islands. Deshayes' identification of it from Bourbon requires confirmation.

D. HASSELTII Férussac. Pl. 64, fig. 3.

Length 19 cm. Body much swollen behind, tailless. Dorsal slit long, continued much in front of the middle of the animal's length. Posterior disk very large, bounded by a conspicuously fringed ridge. Entire surface bearing long foliated fleshy processes. Green, closely dappled with large brown spots, blackish in the middle, and often with some pale and black dots. Shell unknown.

Java (van Hasselt); *Philippines* (Chierchia).

Dolabella rumphii VAN HASSELT, Algem. Konst en Letter-bode, 1824, p. .—*Aplysia hasseltii* FER. in RANG, Hist. Nat. Aplys., p. 49, pl. 24, f. 1 (1828).—Q. & G., Zool. de l'Astrol., ii, p. 306, pl. 23, f. 1–3.—MAZZARELLI & ZUCCARDI, Boll. Soc. Nat. Napoli, iii, 1889, p. 47.

This species is known only by a drawing by van Hasselt, copied by Rang, and here reproduced. It may prove identical with the (prior) *D. teremidi*, but is larger, with more developed foliated appendages on the body and fringing the border of the posterior disk.

The following form described from the Sandwich Islands, is, perhaps, a variety:

D. variegata Pease.

Oblong, rugose, covered with small acute tubercles and more or less acute ridges; the tuberculations are scabrous and furnished, as well as the different portions of the body, with pale, soft cirrhi, which are most conspicuous on the head. The posterior portion is obliquely truncated, from which part the body gradually tapers to the head; the surface of the truncation is convex, with the upper margin acutely elevated. The lobes of the mantle are closely appressed, the left overlapping the right, leaving two openings on the back, one a little in advance of the truncation, and the other on its center. Dorsal tentacles stout, deeply grooved laterally and somewhat swollen. Head convex above; oral tentacles short, stout, grooved laterally and much dilated outwards. Foot rugose, truncated in front, and acutely rounded behind, widest posteriorly. Color greenish-olive, variegated with brown, white and green; inside of the lobes light brown dotted with white; a stripe of tawny brown along sides of the foot. Foot dark orange. Length 10 inches. (*Pease*).

Quoy and Gaimard collected a form which they refer to this species as a variety, at Mauritius. This may or may not prove to be the same as the Java species, but the differences between the figures demand notice and comparison. For these purposes Quoy and Gaimard's description here follows:

Var. Pl. 28, figs. 33, 34, 35, 36.

Very large, conical, truncate; roughened by fringes and tubercles; dirty dark green, variegated with brown and buff spots. M. Rang, in his beautiful monograph of the Aplysias, has figured a species drawn by van Hasselt in Java, having much in common

with one observed by us at the Isle of France, which we do not doubt is a variety of it. Our individual is 9–10 inches long, very plump, especially behind, the head being small and oval, a little swollen and well distinguished from the foot, the mouth large and rounded. The entire body is covered with coarse tubercles and papillæ, some of which are branching; they are most numerous behind the head. The foot is slightly differentiated from the upper surface, and is deep sienna color, with greenish tints in some specimens; Flanks and back are dirty green mingled with yellow, with blackish plaques in some places, especially on the rather rounded hind part. Others have brown and yellowish spots on the sides. Shell very large, the spire extremely rugose. This mollusk emits a great quantity of violet liquid. It was found in great abundance during October and November in the warm, quiet waters of the ilots aux Cerfs, at Mauritius.

Compared with the original figure of *D. hasseltii*, this form is more sparsely blotched with dark, and the dorsal slit is much shorter and does not extend so far forward. The value of these characters can only be decided by a comparison of abundant material.

D. ELONGATA Sowerby. Pl. 27, figs. 31, 32.

Soft parts unknown. Shell oblong, arched, much attenuated, concentrically slightly wrinkled within, radiately subplicated, callus spirally plicated, tumid, widely expanded over the back, widely reflected upon the margins as far as the end; terminal margin angular, epidermis brown tending to orange. (*Sowerby*).

Seychelles (Brit. Mus.).

D. elongata SOWB., Conch. Icon., xvi, pl. 1, f. 2a, b (Oct., 1868).

It is barely possible that this may be a monstrous example of *Dolabella rumphii*. It presents, however, an appearance so extremely different, that it would hardly be just to leave it without a name. (*Sowb.*)

D. HEMPRICHII Ehrenberg.

Six inches long; warty; pale green, the posterior corona and two dorsal bands olive-blackish and rugulose. Body elongate conic, attenuated forward, obliquely truncate and very thick behind, with an exactly circular posterior area. Length 6, breadth 2½ inches. Surface warty, especially in a circle around the posterior area and in two bands along the back, the remaining parts being more glabrous. Round posterior area bounded by a crispate, contractile

membrane. Dorsal slit 21 lines long, ending in a round orifice above the middle of posterior disk. Tentacles over two inches from anterior end of slit, 6–9 lines from buccal tentacles. Shell hatchet-shaped, 16 lines long, with deflexed rudimentary twisted spire.

Near to *D. rumphii* in size of shell and form of body, but without cirri, etc.

Cosseir, Red Sea.

D. hemprichii Ehrenb., Symbolæ Physicæ, etc., Decas prima, (1828 or later).

D. ecaudata Rang. Pl. 66, figs. 11, 12, 13 (type); pl. 25, figs. 4, 5 (*tongana* Q. & G.).

Under the above name may be united several described forms agreeing in having the body almost smooth, with low tubercles only, which disappear in large part in alcoholic specimens; tentacles arising unusually near each other; posterior area or disk bounded by a fleshy ridge which is plain and wavy, not serrate or bearing processes.

The color in life is green; preserved specimens varying from blackish-olive to dirty buff.

Shell having the general form of that of *D. rumphii* but narrower, the border of growth straighter, less convex; shoulder rather less produced upward. The cuticle is thin, yellow, fading to whitish above; margins having rather narrow reflexed borders.

Rawak and Waigiou, Moluccas; Islet of Pangai-Modou, near Tongatabu (Quoy & Gaimard); *Upolu* (Godeffroy Exp., in coll. A. N. S. P.); *Home Is., N.-E. Australia* (Brazier).

This species is most nearly allied to *D. californica* Stearns, but the shell of that has the internal border of the shoulder thickened and rugose and the apical callous heavier and rougher, and the two are widely separated geographically. As my synonymy of *ecaudata* is not based upon a study of types, I give below the descriptions of the several forms included.

D. ecaudata Rang. Pl. 66, figs. 11, 12, 13. Length 13½ cm. Smaller than *D. rumphii*, and having no trace of a tail. Surface of body having above, in front, some flat tubercles. Border of the posterior disk not fringed, but merely irregularly undulated. Posterior tentacles arising very close to each other. Color, greenish.

Shell more calloused on the lower surface of the summit than in

D. rumphii, and cuticle of a paler color, very thin and yellow. Length 28 mill.

Waigiou and Rawak (Quoy & Gaimard).

Aplysia ecaudata Rang, Hist. Nat. Aplys., p. 47, pl. 2 (1828).—*D. ecaudata* Braz., Proc. Linn. Soc. N. S. W., ii, p. 89.

This species is smaller than *D. rumphii*, to which it has great resemblance. It is sufficiently distinguished by the absence of a fringe around the posterior disk, and the lack of processes roughening the whole surface of the body. The tentacles are placed nearer together than in other species. The anterior part of the body has some but slightly projecting tubercles, and sometimes brownish spots.

D. truncata Rang. Length 10½ cm. Body tail-less, pale, shaped as in the preceding species, *covered throughout with obtuse tubercles.* Posterior tentacles close, but less so than in *D. ecaudata.*

Shell glassy; white, the summit thick, without callosities, showing 1½ whorls below. Length 18 mill.

Waigiou and Rawak (Quoy & Gaimard).

A. truncata Rang, Hist. Nat. Aplys., p. 47 (1828).

The individual upon which this species was based by Rang is not in condition for detailed description or figuring. It was proposed by him as a species with doubt, and merely to call the attention of naturalists who may handle material from the locality to this form.

D. tongana Quoy & Gaimard. Pl. 25, figs. 4, 5. Body conic, cylindrical, tuberculate, glaucous. This species is a little smaller than rumphii, of a more lengthened form, a little cylindric. Its ears are less wide, and the papillæ are replaced by little rounded tubercles, only very slightly raised, which disappear upon preservation in liquor. The color is generally glaucous. While it inhabits with rumphii, it cannot be confounded with it, nor can it be taken for the young, the length being 6 or 7 inches. The shell is quite small, white, incurved, with a brown spot at the middle of the larger curve, a character perhaps accidental.

Islet of Pangai-Modou, near Tonga (Q. & G.); *San Giacinto, Philippines* (Chierchia).

Aplysia tongana Q. & G., Voy. de l'Astrol. Zool., ii, p. 305, pl. 23, figs. 6, 7 (1832).—*Dolabella tongensis* GRAY, Figs. Moll. Anim., iv, p. 97 (1850).—*D. tongana* MAZ. & ZUCC., Boll. Soc. Nat. Napoli, iii, 1889, p. 50.

D. CALIFORNICA Stearns. Pl. 66, figs. 14, 15, 16, 17, 18.

Description of alcoholic specimens:—Length 12 to 14 cm. Oblong-ovate, broadly rounded behind, Aplysia-like in front. Buccal tentacles ear-like, short and folded about at the middle, not produced toward the mouth; tentacles conic and slit; the very minute eyes in front of them and more separated. Mouth a vertical slit in a papillose disk. Swimming lobes arising at or behind the middle of the animal's length, contiguous. Posterior subcircular area defined by a groove with smooth raised anterior edge, and enclosing a cord. Mantle having a large shell-foramen and a long posterior siphonal fold (fig. 14, S). Genital foramen under the back part of the gill (fig. 14, *g. p.*).

Color (in alcohol) dark olive, or dull brown with more or less black maculation. In life it is said to be "a dark brown and the surface covered with warty papillæ."

Shell solid, with a brown cuticle. Apex with a roughened reflexed callus, continuing along the dorsal margins as a reflexed border over the cuticle.

Mulege Bay, Gulf of California, in pools left by the tide (Fisher); *West coast of Mexico* (Jones).

Dolabella californica STEARNS, Proc. Acad. Nat. Sci. Phila., 1878, p. 395, pl. 7, f. 1, 2 (shell), Feb. 11, 1879; Proc. U. S. Nat. Mus., xvi, pp, 341, 342, 1892; xvii, 1894, p. 158.—PILSBRY, Nautilus, ix, p. 73.

In external appearance, this species seems nearest to *D. ecaudata* and *tongana*, but the posterior area is defined by a far less conspicuous frill, which does not extend to the edges of the dorsal slit. *Dolabella guayaquilensis*, a species known by the shell only, is stated to have the margins "scarcely reflected, callus small, narrow, not continued upon the margins," while in the present species the margins are bounded by unusually broad reflexed callous bands. Traces of sparsely scattered wart-like papillæ are visible on some specimens, mainly posteriorly, but these are not very distinct in the alcoholic

examples. Two of the original lot collected by Fisher are before me, the smaller one being drawn in my figure, and another specimen of a dark olive color, collected by Dr. W. H. Jones on the "west coast of Mexico," has also been examined.

D. GUAYAQUILENSIS (Petit) Sowerby. Pl. 64, figs. 1, 2.

Shell small, thin, wide, oblong, rather straight, with margin scarcely reflected; back striated: callus small, narrower, tumid, not continued upon the margins; epidermis pale gray. (*Sowb.*)

Guayaquil (Brit. Mus.)

D. guayaquilensis Petit, SOWERBY, Conch. Icon., xvi, pl. 2, f. 6a, b (Oct., 1868).

A glance at the figure of the young *Dolabella rumphii* will be sufficient to explain the difference between the two species, and to show that the small shells from Guayaquil are not the young of *D. rumphii.* (*Sowb.*)

Spurious and doubtful species of Dolabella.

Dolabella fragilis Lam., An. s. Vert., vi, (2d pt.), p. 42 (1822), figured by Delessert, Recueil, pl. 25, f. 9*a-c*, is the shell of *Tethys depilans.*

Leuconyx tyleriana Ad., Ann. Mag. N. H. (3), xi, p. 18, supposed to be allied to *Dolabella*, is the detached process (myophore) of *Pholas costata.*

Dolabella rondeletii Cuvier, Regne Anim. (first edition, 1817), ii, p. 398, founded on Rondelet's Libri de Piscibus Marinis, p. 520, woodcut, is *Tethys leporina* Linn.

Dolabella sp. Two figures given in M. E. Gray's Figs. Moll. Anim., iii, pl. 270, copied from sketches made by Templeton in Ceylon, probably represent (1) *D. ecaudata*, and (2) *D. scapula.*

Dolabella lepus Risso, Hist. Nat. Eur. Mérid., p. 44, is *Tethys leporina?*

Dolabella lævis Blainv. = Tethys depilans Linné.

Dolabella dolabrifera Cuv. = Dolabrifera dolabrifera Cuvier.

The genus SYMPTERUS Rafinesque, Analyse de la Nature, ou Tabl. de l'Univers et des Corps Organises, 1815, p. 142, is placed by Rafinesque between *Laplysia* and *Dolabella*. It is an absolutely nude name.

Genus NOTARCHUS (page 135).

APLYSIA SALTATOR Forbes. A. corpore globoso, griseo albo nigroque maculato, tuberculato, tuberculis mucronatis; sinu branchali parvo; pede augustissimo, tentacules brevibus.

Long. 2 unc.; Altitude $1\frac{2}{10}$. Hab. 20–30 fms. Serpho Bay [Ægean Sea]. (*Forbes*, in Rep. Brit. Asso. Adv. Sci., 1843, p. 187).

Family *OXYNOEIDÆ* Fischer.

Animal elongated, narrow, with rolled tentacles and well-developed pleuropodial lobes. Male orifice near the right tentacle; female orifice on the right side at the edge of the mantle cavity; no external groove between the orifices, the vas deferens being internal. Gill composed of numerous delicate parallel leaflets, depending from the roof of mantle-cavity, not forming a free plume. Radula composed of a single series of lance-like teeth. Shell Bulliform, external, involute with concealed spire, thin and fragile, oval, incapable of containing the soft parts.

The genera composing this group were referred by Pagenstecher in 1874 to a new Order which he called *Monostichoglossata*, includcluding *Limapontia*, *Elysia*, *Lophocercus* and *Lobiger;* the group being based mainly on the peculiar radula. Later, Bergh (Malak. Untersuch.) forms a group Ascoglossa; and von Ihering, in 1877 (Vergleich. Anat. Nervensyst, p. 196), names the Order *Sacoglossa*, including *Limapontiidæ*, *Elysiidæ*, *Phyllobranchidæ*, *Placobranchidæ*, *Hermæidæ* and *Lophocercidæ*. Mazzarelli, in 1892 (Bull. Soc. Nat. Napoli, p. 98, and Mem. Soc. Ital. Sci. (3), ix, p. 1), investigated the anatomy of *Lobiger*, finding the nephridia as in many Nudibranchs, nervous system as in Ascoglossa; generative organs fundamentally Ascoglossan, but the ovary and testis are separated. He concludes that the *Oxynoeidæ* represent the most primitive Ascoglossa, derived phylogenetically from the more primitive Tectibranchs (Bulloidea) near the point of origin of the Pleurobranchs.

On the other hand, *Oxynoeidæ* differ from the Ascoglossa in having a well-developed shell in the adult, a true gill (although differing much from the normal Tectibranch gill), and in the compact

liver, which is, however, composed of closely packed ramifying tubes. The group is therefore intermediate between *Tectibranchiata* and *Ascoglossa*, but nearer the latter.

Synopsis of Genera.

A. Pleuropodial lobes short, not produced in lateral processes; shell globose-ovate, with a deep sutural sinus above (as in *Akera*); the apex concealed, vertex not umbilicated. Genus OXYNOE.

AA. Pleuropodial lobes produced in spatulate or expanded lateral processes; shell semi-ovate, the lip produced above the vertex but not incised, apex concealed, not terminal.

Genus LOBIGER.

a. Tentacles two.

b. Lateral pleuropodial processes four,

Subgenus *Lobiger*.

bb. Lateral pleuropodial processes two,

Subgenus *Dipterophysis*.

aa. Tentacles four; lateral processes four,

Subgenus *Pterygophysis*.

Genus OXYNOE Rafinesque, 1819.

Oxynoe RAF., Analyse de la Nature, ou Tableau de l'Univers et des Corps Organises, 1815, p. 143 (nude name); Journal de Physique, de Chimie, d'Hist. Nat., etc., lxxxix, 1819, p. 152.—*Lophocercus* KROHN, Ann. Sci. Nat. (3), vii, 1847, p. 55.—*Icarus* FORBES, Rep. Brit. Asso. Adv. Sci., 1843, p. 187 (1844).

All of the generic names cited above were based upon the Mediterranean species *O. olivacea*.

Of the six species described, but one is at all fully known; the shells only of the others being figured.

Geographic distribution of Species.

Mediterranean: *O. olivacea*.
West Indies: *O. antillarum*.
Indo-Pacific: *O. krohni*, *O. viridis*, Sandwich Is.
O. delicatula, Ceylon.
O. hargravesi, New Hebrides.

O. OLIVACEA Rafinesque. Frontispiece, fig. 17; Pl. 11, figs. 43, 44, 46–50, 58–62 (enlarged).

Shell external, thin, fragile, pellucid and shining, convolute, globose; truncate and slightly contracted at summit, rounded and dilated at base. Last whorl very large, completely detached from the spire by the deeply incised sutural slit. Aperture very large, angled above, rounded below; lip arcuate, simple and acute; columellar margin with a very thin film of callus above, concave below, acute, forming an open spiral through which the interior of the whorls may be seen from the base. Color uniform glassy white, with a thin transparent and shining, very light yellow cuticle.

Alt. 12, diam. 9 mill. (*B. D. & D.*).

Body elongated, swollen in front of the middle, with the tail long and narrow, pleuropodial lobes partly covering the shell, *the line of their junction forming a crest or ridge the entire length of the tail.* Upper side of tentacles and outer surface of pleuropodia and tail papillose. Color above clear green, the borders of the foot and pleuropodial lobes, and ends of the tentacles margined with alternating spots of pale red and blue-black. Sole yellowish (*Krohn*).

Mediterranean Sea: Syra, Serpho, Grecian Archipelago (Forbes); *Sicily* (Raf., Monts.); *Malta* (Soul.); *southern France, at Canet* (B. D. & D.); *Balearic Is.* (Pagenstecher) in the laminarian zone.

Oxynoe olivacea Rafinesque, Journ. de Physique lxxxix, 1819, p. 152; Binney & Tryon's reprint, p. 33.—Morch, Journ de Conch., 1863, p. 44.—Weinkauff, Conch des Mittelmeeres, ii, p. 180.—Jeffreys, Rep. Brit. Ass. Adv. Sci., 1873, p. 114.—Monterosato, Journ. de Conchyl., 1878, p. 158.—Buquoy, Dautzenb. & Dollfus, Moll. Mar. Rouss. i, p. 549, pl. 63, f. 16, 17 (shell).—*Bulla gargottæ* Calcara Monogr. dei gen. Claus. e Bul. ecc., p. 45 (1840).—*Icarus gravesi* Forbes, Rep. Æg. Invert., Rep. Brit. Ass. Adv. Sci., 1844, pp. 134, 187.—*Lophocercus sieboldi* Krohn, Ann. Sc. Nat. (3), vii, p. 55, pl. 2, f. 5–9, 11 (1847).—Souleyet, Journ. de Conchyl., i, 1850, p. 235, pl. 10, f. 1–12.—H. & A. Ad., Gen. Rec. Moll., ii, p. 30, pl. 59, f. 1, 1a.—Chenu, Manuel de Conch., i, p. 394, f. 2989, 2990.—Pagenstecher, Verh. Naturhist.-Medicinischen Vereins zu Heidelberg (n. F.), i, p. 58, 1874 (Anatomy and systematic position).—*Bulla (Lophocercus) sieboldi* A. Adams, in Sowb., Thesaurus, pl. 119, f. 19 (copy from Krohn).—*Oxynoe sieboldi* Weinkauff, Conch. des Mittelm., ii, p. 181.—Fischer, Man. Conch., p. 570, f. 333.—*Oxynoe brachycephalus* Morch, Journ. de Conchyl., 1863, p. 45 (based on H. & A. Adams' figure).

O. brachycephalus Mörch was based on the figures of H. & A. Adams (copied by Chenu, and on my plate 11, figs. 56, 57). Its differential characters are: warts on the body remote; neck very short; shell contracted at summit.

O. sieboldi Krohn (see pl. 11, figs. 58–62) is considered distinct by Mörch on account of the presence of a red and dark dotted border along foot and pleuropodia. This border is less distinct or perhaps lacking in the *olivacea*, to which he refers Souleyet's figures (see pl. 11, f. 43, 44, 46–50). Monterosato is doubtless right, however, in considering all of these forms identical.

Pagenstecher thus describes the coloring of his specimens from Balearic Is., where they were found in 15–30 feet of water.

Length 2·5 to 5 cm., including the tentacles. Ground-color is clear olive-green with numerous white and light-brown or light-yellow flecks, which are frequently raised into granules, or stronger warts, or even sub-divided papillæ. The two large, non-retractile, laterally rolled tentacles and the margin of the narrow foot are marbled with yellowish- and gray-brown; sole pale yellow. Dorsal surface of the tail-like posterior part of the body is sharply carinated, and in places it is brownish, to the suppression of the green ground-color, with dark dots in addition to the light papillæ. Enrolled surface of tentacles pale yellow. Free margin of the reflexed lateral lobes marbled with brown; while the green color is strongest and purest on the neck.

O. ANTILLARUM Mörch. Pl. 53, fig. 90.

Body green, oval; tail very long, narrow, with a wide longitudinal white dorsal band; closely dotted with green; tentacles and sides of the head white, with rather remote green dots arranged in series. Epipodial lobes with acute, conic, close warts, its edge white with irregular green dots. Sole of the foot yellowish, narrow, the margin with a row of regular close green dots (*Mörch, from a drawing by Œrsted*).

Shell involute, ovate, hyaline-white, swollen above, very slightly contracted immediately below the vertex, shining, with some irregular wrinkles of growth. Spire concealed. Suture a deep lunate incision. Aperture very large, broadly ovate below, narrow above; outer lip sinuous, produced forward above.

Alt. 6–6¼, diam. 4½ mill.

St. Thomas (Œrsted).

Oxynoe antillarum Mch., Journal de Conchyl., 1863, p. 27; Malak. Bl., xxii, p. 179.

The shell here figured was received from Mörch.

O. KROHNII A. Adams. *Unfigured.*

Shell involute, ovate-oblong, gibbous posteriorly, at the apex subangulate and plicate; spire concealed; white, shining, fragile, pellucid. Aperture oval, acute behind, dilated in front; lip solute behind, with an inflexed, rounded angle (*Ad.*).

Sandwich Is. (Mus. Cuming).

Lophocercus krohnii A. Ad., P. Z. S., 1854, p. 94.—*Lobiger krohnii* H. & A. Ad., Genera, ii, p. 31.—*Oxynoe krohnii* Morch, Journ. de Conch., 1863, p. 46.

This species is more gibbose posteriorly than *L. sieboldii.* The region of the spire is plicate, and the shell is pellucid, white and fragile (Ad.).

O. VIRIDIS Pease. Pl. 11, figs. 51–55.

Shell thin, pellucid, fragile, white, slightly convolute, obliquely finely striate, left side slightly inflated; aperture large, open widely; outer lip disjoined from the apex, very slightly produced posteriorly and truncate; inner lip slightly callous.

Body oval or ovate, dorsal region elevated, lateral lobes regular in shape, outline of the edges convex, not meeting; tentacles well-developed, grooved and truncated; eyes immersed immediately behind the tentacles; foot linear, adapted for clasping sea-weed; the whole upper surface garnished with more or less numerous cirrigerous appendages. Tail long, compressed and lance-pointed. Color grass green, mottled with darker, sometimes dotted minutely with brown, or a few blue spots margined with black along the edge of the lateral lobes and on the neck. (*Pse.*).

Huahine (Pse); *Tahiti* (Mts.); on sea-weed in shallow water.

Lophocercus viridis Pease, P. Z. S., 1861, p. 246; Amer. Journ. Conch., iv, p. 74, pl. 8, f. 1, 2; pl. 12, f. 25.—Mts. & Langk., Donum Bismarckianum, p. 54, pl. 3, f. 4a, b.—*Oxynoe viridis* Morch, Journ. de Conchyl., 1863, p. 46.

O. DELICATULA G. & H. Nevill. Frontispiece, figs. 1, 2, 3.

Shell ovate, involute, a little contracted and truncate behind, rounded in front, whitish, thin. Aperture subcircular behind, ovate in front, elongated, dilated, margins approximating toward the pos-

terior terminations, inner lip smooth and thin, outer lip a little inflexed behind, its edge acute. Alt. 6, diam. 3·5 mill. (*Nev.*).

Southern province of Ceylon (Nevill) ; *"Sow and Pigs" reef, Port Jackson, Australia* (Brazier).

Oxynoe delicatula Nev., Journ. Asiat. Soc. Beng., xxxviii, pt. 2, 67, pl. 13, f. 5.—*Lophocercus delicatulus* Angas, P. Z. S., 1877, p. 190.

The much smaller expansion of the outer lip, etc., at once distinguishes this species from *O. sieboldi*, which it most resembles. The animal of this species proves it to be a true *Oxynoe*. It is of a pale sea-green color, spotted with round torquoise-blue spots. It is found on reefs in very shallow water. (*Nev.*).

O. hargravesi H. Adams. Frontispiece, fig. 4.

Shell very thin, subpellucid, ovoid, produced behind, involute, white, ornamented with longitudinal opaque streaks following the lines of growth. Aperture ample, rounded below, narrowed above; inner lip thin, slightly reflexed; outer lip acute, inflexed above. Alt. 7, diam. 4½ mill. (*Ad.*).

New Hebrides (coll. Hargraves).

Oxynoe hargravesi H. Ad., P. Z. S., 1872, p. 15, pl. 3, f. 30.

Genus LOBIGER Krohn, 1847.

Lobiger Krohn, Ann. Sci. Nat. (3), vii, p. 52. Type *L. philippii* =*L. serradifalci* Calc.

The species are few, but widely dispersed, coinciding remarkably with *Oxynoe*, in distribution. Only *L. serradifalci* has been satisfactorily investigated.

Geographic distribution of species.

Mediterranean: *L. serradifalci* (p. 167).
West Indies: *L. souverbii* (*Dipterophysis*, p. 168).
Indo-Pacific: *L. viridis*, Sandwich Is. (*Pterygophysis*, p. 169).
L. nevilli, Ceylon, (p. 168).
L. wilsoni, S. Australia (p. 168).

The locality of *L. pellucidus* Ad. is unknown.

Lobiger cumingi A. Ad. is a species of *Volvatella* (see Man. Conch., xv, p. 385).

L. SERRADIFALCI Calcara. Pl. 10, figs. 27, 28, 29, 30, 31, 32, 33, 36.

Shell ovate, delicate thin and fragile, subtransparent, and corneous; delicately striated; involute, the spire umbilicated. Aperture as long as the shell, oblong, narrowed above, broadly rounded below, produced far above the apex of the shell. Outer lip regularly arcuate, basal lip effuse, columella thin, broadly concave below, with a conspicuous reflexed margin across the preceding whorl. Alt. 12½, diam. 8½ mill.

Animal elongated, the posterior part and outer surface of pleuropodial lobes bearing numerous scattered conic papillæ. Color citron-yellow, with a perceptible greenish tinge, the sole a more diluted tint. Pleuropodial lobes broad and rounded, with narrow bases; edged by a white line, within which is a crimson line; the papillæ of the surface showing the same distribution of color. Length slightly exceeding one inch.

Mediterranean Sea: Bay of Palermo (Calcara *et al.*); *Messina* (Krohn); *Bay of Naples* (Mazzarelli); *Gulf of Marseilles* (Vayssiere).

Lobiger philippii KROHN, Ann. Sci. Nat. (3), vii, 1847, p. 52, pl. 2, f. 1, 2.—SOULEYET, Journ. de Conch., 1850, p. 232, pl. 10, f. 13, 14 (shell).—FISCHER, Journ. de Conch., vii, 1856, p. 274.—A. ADAMS, in Sowb., Thes., ii, pp. 598, 602, pl. 121, f. 57; pl. 119, f. 18.—MORCH, Journ. de Conch., 1863, p. 47.—VAYSSIERE, Rech. Zool. Moll. Opistobr., Tectibranches, in Ann. Mus. d'Hist. Nat. Marseille, Zool., ii, pp. 177, 100.—*Bullea serradifalci* CALCARA, Monografie dei generi Clausilia e Bulimo, coll' aggiunta di alcune nuove specie di Conchiglie Siciliane, p. 44 (1840).—*Lobiger serradifalci* MONTS., Journ. de Conch., 1878, p. 159.—MAZZARELLI, Boll. della Società di Naturalisti in Napoli, vi, 1892, p. 98 (anatomy).—*Lobiger corneus* MORCH, Journ. de Conch., 1863, p. 48 (based solely upon figure of shell in Thes. Conch., pl. 121, f. 57).

The first description of this species is that of Calcara in 1840, Krohn's being seven years later. Mörch's *L. corneus* is utterly without distinctive characters.

L. PELLUCIDUS A. Adams.

Shell oval, subinvolute, white, fragile, pellucid; longitudinally substriate, the spire concealed. Aperture oblong, ample, produced and somewhat narrowed behind, dilated in front; inner lip thin, subreflexed, outer lip arcuate with the margin acute. (*Ad.*).

Habitat unknown (Cuming coll.).

Lobiger pellucidus A. Ad., P. Z. S., 1854, p. 94.—*Lophocercus pellucidus* Adams, Gen. Rec. Moll., ii, p. 31.—Fischer, Journ. de Conchyl., 1856, p. 274 (copy of original description).—*Oxynoe pellucida* Morch, Journ. de Conch., 1863, p. 46.

This species differs from *L. philippii* in being white and nearly pellucid, and from *L. cumingii* in the very different form of the aperture, this not being produced into a narrow spout-like canal posteriorly. (*Ad.*).

L. nevilli Pilsbry, n. n. Pl. 10, figs. 34, 35.

Shell ovate, involute, thin, greenish, the last whorl much inflated behind. Aperture oblong, attenuated and rounded in front, shortly produced and somewhat narrowed behind; inner lip thin, in part straight, smooth, slightly elevated; outer lip arcuately expanded, thin at the edge. Alt. 5·5, diam. 3·5 mill. (*Nev.*).

Southern province of Ceylon.

Lobiger viridis G. & H. Nevill, Journ. Asiat. Soc. Beng., xxxviii, pt. 2, p. 68, pl. 13, f. 6 (1869).—Not *L. viridis* Pease, 1863.

L. nevilli differs from the other species of the same genus in being anteriorly much more gradually rounded, as also by its great tumidity near the spire. (*Nevill.*).

L. wilsoni Tate. Frontispiece, fig. 5.

Animal with the body produced into a very narrow, pointed, smooth tail of a green color, shortly extended beyond the shell. Foot with two oblong-rounded and pale-green lobes, which are somewhat attenuated into a broadish stalk.

Shell thin, flexible, straw-yellow; spire rudimentary but involute. Somewhat pyriform, slightly attenuated in front, and truncated apically; aperture narrow-ovate, truncate behind. Surface finely striated. Length 8, width 5 mill. (*Tate*).

Lower end of South Channel of Port Phillip, South Australia, seven to sixteen fathoms (J. B. Wilson).

Lobiger wilsoni Tate, Trans. and Proc. and Rep. Roy. Soc. South Australia, xi, p. 66, pl. 11, f. 12 (1889).—Wilson, Proc. Roy. Soc. Victoria (n. ser.) ii, p. 66 (1890).

Subgenus Dipterophysis Pilsbry, 1896.

Like *Lobiger*, but with a single pleuropodial lobe on each side.

L. souverbii Fischer. Pl. 10, figs. 39, 40, 41, 42.

Shell ovoid, thin, pellucid, longitudinally striated, dilated in the middle, obliquely truncated in front, rounded behind and slightly

produced. Aperture semioval, obliquely truncated in front, subangulated behind; columellar lip thin, with a thin, narrow callus recurved over the spire; outer lip thin, arcuate and simple.

Alt. 7, diam. 5 mill. Swimming lobes two, one anterior, the other posterior. (*Fischer.*)

Guadeloupe, West Indies.

L. souverbii Fisch., Journ. de Conchyl., v, 1856, p. 273, pl. 11, f. 7–10.—*L. sowerbyi* Fisch., Morch, Malak. Bl., xxii, p. 179.

Differs from the other forms known in the single pleuropodial lobe on each side.

Subgenus Pterygophysis Fischer, 1883.

Pterygophysis Fischer, Man. de Conch., p. 571.

Four tentacles developed on head; pleuropodial lobes four, very long, with scalloped edges.

L. viridis Pease. Pl. 10, figs. 37, 38.

Shell ovate, rather thin, longitudinally striated, white, covered with a yellowish epidermis; left margin slightly dilated. Aperture oblong-oval, rounded in front, produced, contracted and subangulate behind. Spire involute, concealed; lip slightly arcuate, its margin acute. (*Pse.*).

Animal elongate; tail, margins of the foot and centre of natatory lobes papillose; tail long, arched, gradually tapering to a rounded point. Tentacles four, auriform, subconvolute, somewhat dilated at the ends and truncate. Eyes immersed behind the posterior pair. Natatory appendages thin, elongate, anterior pair rather less than the whole length of the animal, posterior pair a little shorter than the anterior, widest at their outer halves, and their sides deeply incised, giving them a leaf-like appearance. Locomotive disk like Aplysia. Color pale pea-green, tips of the tentacles tinged with yellow, a dusky marginal band along the edge of the body; the upper surfaces of the natatory lobes are greenish centrally, fading into yellowish pink towards the margins, which are white; lower surface of same color, but brighter, and margins dusky.

Tahiti (Mts.); *Huahine,* among sea-weed on sandy bottoms in sheltered places (Pse.).

Lobiger . . . . ? Pease, P. Z. S., 1861, p. 246; *Lobiger viridis* Pease, P. Z. S., 1863, p. 510.—*L. picta* Pse., Amer. Journ.

Conch., iv, p. 75, pl. 8, f. 3; pl. 12, f. 26.—*L. pictus* MARTENS & LANGKAVEL, Donum Bism., p. 54, pl. 3, f. 5.

When disturbed they cast off all their lobes, which retain their vitality for several hours. (*Pse.*).

Pease's dealings with this species have been far from straightforward. He first described it in 1861 without a specific name; then in 1863 he bestowed the name *L. viridis;* and finally, in 1868, he repeated the substance of his first description and renamed the animal *L. picta.*

III. TECTIBRANCHIATA NOTASPIDEA.

Tectibranchs in which the dorsal surface is protected by a large shield ("*notæum*") or mantle, with or without an external or buried shell; no head-shield nor pleuropodial lobes.

Synopsis of Families.

I. Radula with the formula 1.1.1; rhinophores wanting; stomach armed with four large, denticulate plates; shell very small or wanting; small animals, *Runcinidæ.*

II. Radula with very many longitudinal and transverse rows of teeth; rhinophores developed, of the usual slit form.

a. Shell either wanting or thin, auricular or haliotiform, with terminal spiral nucleus, and in part or wholly concealed, *Pleurobranchidæ.*

aa. Shell well-developed, external, patella-like, with the apex near the middle, *Umbraculidæ.*

Family *RUNCINIDÆ* Gray.

Runcinadæ GRAY, Guide to Syst. Dist. Moll. B. M., p. 204.—*Peltidae* VAYSSIERE, Recherches Zool. et Anat. Moll. Opistobr., p. 104.

Shell small and posterior, or obsolete.

Body limaciform, convex above, the mantle or dorsal shield covering the upper surface except the end of foot; separated from foot by a deep groove. Eyes sessile, anterior; tentacles or rhinophores wanting or subobsolete. Foot about as wide as body. Gills posterior on the right side, pinnate with few laminæ. Anus behind the gill. Orifice of female reproductive organs in front of gill; penis

situated further forward, on right side of cephalic region. Stomach armed with four denticulate plates.

Radula with the formula 1.1.1 (pl. 68, f. 36). Jaws present.

A very distinct family of minute limacoid Tectibranchs, resembling *Pleurobranchidæ* somewhat in outward aspect, but differing widely in the dentition, the stomach-armature and the absence of rhinophores. Pelseneer believes *Runcinidæ* to belong to the *Cephalaspidea* (Chall. Rep. Zool. pt. lxvi, p. 97); I think this likely.

The original discoverer of the European species, Quatrefages, placed it in his supposed degenerate group "Phlebenterata," characterized by lack of a circulating system, anus, etc. Forbes, who rediscovered it on the English coast, placed the group next to *Limapontia*, an arrangement in which some other authors concurred. Gray, however, in 1857, decided its affinities to be with *Pleurobranchidæ*, *Umbrellidæ* and *Tylodinidæ*, a position retained by Vayssière. The important work on the group by the latter author, together with that of Bergh on the genus *Ildica*, supplies all that is yet known of the internal anatomy of *Runcinidæ*.

Synopsis of Genera.

Genus Runcina Forbes.

Tentacles or rhinophores none. Teeth of the radula denticulate. Shell reduced to a minute vestige buried in the posterior part of the integument.

Genus Ildica Bergh.

Small labial tentacles developed. Teeth not denticulate. Shell a small non-spiral calcareous plate, external and posterior on the back.

Genus RUNCINA Forbes, 1853.

Runcina Forbes, Hist. Brit. Moll., iii, p. 611, type *R. hancocki*.—*Pelta* Quatrefages, Ann. Sci. Nat. (3), i, p. 151 (1844), type *P. coronata*.—Vayssiere, Ann. Sci. Nat. (6), xv, p. 6 (1883). Not *Pelta* Beck, Index Moll., p. 100 (1837).

Shell membranous, internal and minute. Body lengthened, limaciform; no tentacles at sides of mouth. Teeth of radula denticulate. Type *R. coronata*.

Two very small species are known. They have the general aspect of the Limapontias, but are readily distinguished on superficial examination, by the gill.

R. CORONATA Quatrefages. Pl. 68, figs. 31–41.

Animal presenting a smooth body covered with vibratile cilia; mantle quite convex, visibly emarginate in front, extending a little on the sides, incompletely covering the foot, rounded behind; color black, with minute brown dots, except in front and at the hind end, where it is a more or less light fawn tint. Eyes sunken in the integument, rather large, each surrounded by a pale stripe; behind the eyes there is usually on each side a curved line of little white spots, forming a sort of continuation of the light colored frontal region.

Foot yellowish (pale ochre), sometimes marked with black spots or flames; its forward margin is perceptibly concave; sides nearly parallel, and towards the head it is slightly wider than the mantle; tail end extending beyond the mantle about a fourth the length of body.

The semipinnate gill is composed of 3 or 4 little plates, and projects slightly behind the dorsal integument on the right side (see fig. 39).

Formula of teeth 1.1.1; jaws triangular, wide, formed of little chitinous pieces of more or less polyhedral form, well separated from each other. Gizzard with 4 equal cartilagino-calcareous pieces (pl. 68, figs. 33, 34).

Length of animal, 4 to 5 mill.

Bréhat Island, off N. Brittany (Quatrefages); *Torbay, England* (Alder & Hancock); *Belmont Bay, near Weymouth* (Thompson): *Clyde district* (Norman); *Gulf of Marseilles* (Vayssiére).

Pelta coronata QUATREF., Ann. Sci. Nat. (3), i, 1844, p. 151.—VAYSSIERE, Ann. Sci. Nat. (6), xv, 1883, p. 6, pl. 1, f. 1–12; pl. 2, f. 13–21; Rech. Zool., Moll. Opistobr., Tectibr., p. 104, pl. 5, f. 126–129.—*Pelta ornata* QUATREF., *t. c.*, p. 152.—*Pelta* or *Limapontia* ALDER & HANCOCK, Ann. Mag. Nat. Hist., xviii, November, 1846, p. 289, pl. 4, f. 1–7.—*Runcina hancocki* FORBES, Hist. Brit. Moll., iii, p. 612, pl. CCC, f. 2.—GRAY, Guide Syst. Dist. Moll. B. M., p. 205, f. 114 (dentition).—H. & A. Ad., Gen. Rec. Moll., ii, p. 43, pl. 61, f. 5.—JEFFREYS, Brit. Conch., v, p. 15, pl. 1, f. 3.—*Pelta nigra* "Alder &

Hancock," CHENU, Manuel de Conch., p. 416, f. 3087.—*Runcina viridis* F. & H., Hist. Brit. Moll., iii, p. x of index (error).

The species varies considerable in intensity of color, and sometimes lacks light rings around the eyes. They are extensile and very active.

Vayssiére found a very minute, delicate, non-calcareous disk beneath the hinder part of the mantle, which may be the vestige of a shell.

R. PRASINA Mörch. Pl. 68, figs. 42, 43.

Body linear, elongated with subparallel sides, the anterior margin lightly curved inward; mantle green, with regularly spaced, close, minute warts, the posterior margin three-lobed, the median lobe smallest; dorsal part of mantle elevated, convex, of a deeper color; eyes black, very far apart toward the front. Foot slightly wider than mantle, somewhat projecting and broadly rounded behind; yellowish-green. Stomach-plates (fig. 43) nearly semi-circular, with rather remote, obtuse, strong and arcuate teeth.

Length about 4 mill. (*Mörch*).

St. Croix, West Indies, near Christianstad (Œrsted).

Pelta prasina MORCH, Journ. de Conchyl., 1863, p. 42.—BERGH, Malacol. Unters., iv, 1872, pl. 24, f. 27–29.

It is narrower than *R. coronata*, with the mantle trilobate behind and the eyes more anterior. Mörch's description and Bergh's figures were from drawings by Œrsted.

Genus ILDICA Bergh, 1889.

Ildica BGH., Malac. Untersuchungen, iii, Anhang, p. 869.

Notæum continuous, the mantle-edge projecting somewhat over the sides of the body all around. Shell small, posterior, uncovered. Branchial plume simple, posterior on the right side of body, projecting. Head small, with a small tentacle on each side of the mouth. Foot rather broad, tail short.

Labial armature composed of minute rods. Radula with median teeth and hamate laterals. Stomach armed with 4 strong denticulate triturating plates.

Ildica has an external resemblance to *Pleurobranchus*, on account of its extended notæum.

I. NANA Bergh. Pl. 69, figs. 50–57.

Form oval, 2 to 2·5 mill. long, 1·3 to 1·4 mill. high. Color of the back blackish or black, strongly contrasted with the chalk-white shell. Sides of body slightly lighter, but anteriorly coal-black, like the head, the gill grayish; foot the color of the sides, the viscera showing whitish through it anteriorly. Back even, pretty convex, with the forward slope longest, posteriorly rounded; anteriorly little narrower with the acute, narrow margins of the body slightly projecting.

On the hind end of the body, lying slightly to the right or median, is the chalk-white shell (see figs. 52, 53,) placed parallel with the axis of body or inconspicuously oblique, sometimes sunken in a slight depression.

The shell (figs. 50, 51) is chalk-white, somewhat variable in form, generally long-oval, with pretty parallel side-margins, in front somewhat truncate, behind rounded, about ·4 mill. long, ·16 wide. It is thin but not especially fragile, hardly thinner at the edges, strongly adhering to the integument, level and without any distinct growth-striæ. It effervesces violently with acid, and an organic substratum of the form of the shell is left.

Anteriorly on the back there is no trace of eyes or tentacles. Sides of the body not very low, gradually rising toward the posterior. Behind on the right side is the longitudinal gill, which seems to be simple, feathery, and projects slightly beyond the tail. Behind it seems to be the anal opening; and before, on the right side, the minute genital orifice. The head is quite small with perpendicular mouth, on each side of which is a quite small tentacle, perhaps with longitudinal furrows. Sole nearly as wide as the back, roundly truncate in front, with fine marginal grooves; the back end (or short tail) somewhat tapering, rounded, somewhat projecting.

Radula (figs. 54, 55) not very narrow, with, as it appears, 12 to 13 rows of teeth; further backward there seem to be 18 to 19 developed, and two younger rows; the entire number, therefore, 32 to 34. The tooth-rows seem, as well as could be judged from the poor condition of the material, to have a lateral on each side of the median tooth. The median tooth (fig. 54) is wide, in the form of a crescent, with an indication of a reduced denticle on each side. Laterals (fig. 55) shaped as in *Philine*, with the margin smooth, not denticulate.

The stomach contained, in two individuals examined, 4 strong, erect, yellowish or nearly glassy-clear lunate plates (fig. 57), the

free margins of which have a row, in part doubled, of short, strong, irregular denticles.

Mauritius, in stomach of the nudibranch Trevelyana crocea.

Ildica nana Bgh., Malac. Unters., ii, Anhang, p. 870, pl. 82, f. 27–38.

Two individuals with part of another were found in the stomach of a nudibranch.

Pl. 69, figs. 52, 53, animal enlarged, view of the right side and above; fig. 50, shells; fig. 55, lateral tooth, from above; fig. 54, two rows of teeth, showing the lunate centrals in the middle, laterals on each side; fig. 57, stomach plates.

Family *UMBRACULIDÆ.*

=*Umbrellidæ* Auct.

Shell external, limpet-like, with the nucleus minute and sinistral, vertex near the center; inside with a circular, closed muscle-impression.

Foot oval or oblong, adapted for creeping, without pleuropodial processes. Head bearing two laterally-slit tentacles, the eyes sessile at their inner-anterior bases. Mantle the size and shape of the shell, with thin, serrate edge. Gill a long plume lying between mantle and foot on the anterior and right side, adnate and bearing numerous bipinnate branches for the greater part of its length, posterior end free and bipinnate. Anus tubular, projecting behind the gill. Mouth with labial tentacular or plate-like processes; radula very broad, bearing a great number of similar, very narrow, crowded, needle-like teeth, with recurved simple cusps, which are not differentiated from the body of tooth.

Distribution, world wide in tropical and subtropical seas, laminarian zone and deeper.

This very distinct family is composed of two genera, strongly divergent in the relations of the male genitalia and gill.

Genus Umbraculum Schumacher, 1817.

Foot very fleshy, large, oval, with a deep anterior sinus in which the mouth-parts are situated. Gill a long adnate plume, extending across the front and along the right side, free and bipinnate behind. Penis external, lying in the anterior sinus of the foot, in the median line in front of and below the head. Shell depressed, entirely calcified, with the vertex to the left of the middle.

Subgenus *Umbraculum*. Shell sinistral, with growth-lines and some faint, low, wide-spaced radial ridges (page 117).

Subgenus *Hyalopatina* Dall. Shell dextral, the nucleus sinistral; sculptured with very numerous radiating lines of minute elevated points (page 184).

See also, *Bertinia* Jousseaume (page 189).

Genus Tylodina Rafinesque, 1819.

Foot long-oval, without anterior sinus. Head large, with prominent anterior tentacles. Gill a short bipinnate plume on the right side posteriorly. Penis retractile, on the right side in front of the gill. Shell with the edges not calcified, vertex subcentral (page 185).

Genus UMBRACULUM Schumacher, 1817.

Patella sp. of Gmelin, Martyn and some other early authors.

Acardo Lam., (in part), Syst. An. s. Vert., p. 130 (1801).—Megerle von Muhlfeld, Gesellsch. Naturforsch. Fr. Berl., Mag. für die Neuesten Entdeckungen, etc., v, p. 63 (1811).—Not *Acardo* Commerçon *MS.* in Bruguière, Encycl. Méth., i, p. 1 (1792),=Epiphysis of whale, *teste* Deshayes, Encycl. Méth., edit. 1830, p. 1.

Umbraculum Schumacher, Essai Nouv. Syst. Vers Test., pp. 55, 177 (1817).

Gastroplax Blainv., Bull. Sci. Soc. Philomathique for 1819, p. 182.

Umbrella Lamarck, Anim. s. Vert., vi, p. 343 (1819).

Ombrella Blainville, Dict. Sci. Nat., xxxii, p. 267 (1824).

Umbella Orb., Moll. Cuba, i, 115 (1841).

Operculatum H. & A. Ad., Gen. Rec. Moll., ii, p. 41 (1854), and of Linné, Mus. Tess., 1753, not binomial.

Shell patelliform, depressed, sinistral; the vertex to the left of and somewhat behind the center, usually colored, more or less conically elevated, apex curved backward, when perfect forming a minute spiral of scarcely over one whorl.

Soft parts much larger than the shell. Foot very voluminous, tuberculate above, with the sole very broad, oval; deeply slit in front, the mouth situated at the bottom of the sinus, with plate-like labial processes in front of it. Head projecting but little in front of mantle, bearing two tentacles slit down their outer sides, the small eyes at their inner, anterior bases; penis in front of head, lying in

the anterior slit. Mantle with thin edge fringed by numerous flat processes. Gill a long plume arising in front under the mantle, and continued along the right side, its latter end free and bipinnate.

Radula extremely wide, composed of an enormous number of perfectly similar, very narrow, needle-like teeth, strongly recurved toward their apices, the cusps narrowly lanceolate and smooth.

Type *Umbraculum sinicum* Gmel.

The radula of *Umbraculum sinicum* which I examined, has more numerous teeth than any other mollusk known to me. Among Tectibranchs, *Dolabella* has a somewhat similar type of teeth, but they are wider and much larger. The general characters of the teeth are as in *Pleurobranchidæ*.

The name *Umbraculum* of Schumacher is the earliest tenable designation for this group, although it had previously been recognized as a genus distinct from *Patella* by Lamarck and Mühlfeld. There are several names anterior to the one commonly known, *Umbrella* Lam.

Distribution: The genus occurs in tropical and subtropical seas of both hemispheres, and is represented in the Eocene of Europe and America. The *U. planulatum* Conrad of Jackson, Mississippi, rivals in size the largest recent species. Two Jurassic forms, of doubtful pertinence to the genus, have been described.

There are but few species, either fossil or recent, and the conchological characters separating them are neither very obvious nor of much value. The soft parts of *U. mediterraneum* and the Sandwich Island form of *U. sinicum* only are known.

Species of Umbraculum.

Panamic region:	*U. ovalis.*
Antillean region:	*U. plicatulum, bermudense.*
Mediterranean region:	*U. mediterraneum.*
Indo-Pacific and	*U. sinicum*, E. Africa to Hawaiian Is.
[Australian regions:	*U. cumingi*, Réunion Island.
	U. pictum, Lord Hood's Island.
	U. corticalis, South Australia.

U. ovalis Carpenter. Pl. 70, fig. 61.

Shell similar to *U. indica*, but the margin scarcely undulating; regularly oval; apex spiral, somewhat projecting, less inequilateral;

epidermis thin, scarcely shining; orange within in adults. (*Cpr.*).
Length 1·93, diam. 1·58 inch. (young shell).

Mouth of the Chiriqui River, Bay of Panama (Bridges).

Umbrella ovalis Cpr., P. Z. S., 1856, p. 161.—Reeve, Conch. Icon., vol. xi, pl. 1, f. 3 (1858).

Concerning this remarkable shell, hitherto only found in the Old World, and, in spite of the bulk of its animal, not observed by either Mr. Cuming, Prof. Adams or Mr. Hinds, Mr. Cuming writes: it was not only brought by Mr. Bridges, but also by a gentlemen in Paris, who collected in exactly the same place. Two specimens are in Mr. Cuming's collection, of which one, very much thickened, appears to have formed part of a much larger shell. (*Cpr.*).

U. plicatulum Martens. Pl. 72, figs. 72, 73, 74.

Shell a little concave, ovate-elliptical, pretty equally rounded in front and behind, with weak wave-like folds, radiating from the apex and especially distinct at the margin, where they are separated by distinctly marked, narrow furrows; concentrically striated above. Apex projecting wart-like, almost in the middle antero-posteriorly (anterior part to posterior as 7 : 6), but rather excentric laterally (left side to the right as 2 : 3). Under side, as in other species of the genus, with a yellowish colored, radially rib-striated middle field, bounded by a double closed line (corresponding to the pallial line of the bivalves), the yellow color elsewhere not very strongly pronounced, more brownish. Length 62, width 46, alt. 7 mill.

Matanzas, Cuba (Gundlach).

Umbrella plicatula Martens, Conchologische Mittheilungen, i, p. 104, pl. 20, f. 1–3.

This species is distinguished from *U. mediterraneum*, as well as from *U. indica* Lam. principally by the more lengthened contour and plication all around. *U. mediterraneum* has only in front a few generally stronger folds, *U. indica* none, *U. cumingi* Desh. from Bourbon, weaker ones, not continuing to the edge.

Description and figures from von Martens. It may prove the same as the undescribed Bermudan species. It seems more allied to *U. ovalis* Cpr. than to other forms.

U. bermudense Mörch.

This is a species of nearly the size of *U. sinicum*. It is known solely by two figures of the living animal drawn by a "young man" for

Dr. George Forbes in 1758, and published in the Philosophical Transactions for that year. These figures are so poor that their reproduction here would be useless; it is enough to say that they show the generic characters fairly well. The mantle edge and border of foot seem to be very ragged. No specimens seem to have occurred to later naturalists. It may be the same as the preceding species; and if so, the latter should have priority, being well described and figured, while this has never been described and the figures are totally inadequate. Mörch is in error in stating that Dr. Forbes called this animal a "sea-batt."

Bermuda (Dr. Geo. Forbes).

Fish . . . of the shell kind, Dr. GEORGE FORBES, in Philos. Trans., l, 1758, p. 859, pl. 35 (1759).—*Operculatum Bermudense* MORCH, Malak. Bl., xxii, p. 179 (based wholly on the figures of Forbes).

U. MEDITERRANEUM Lamarck. Pl. 69, figs. 44, 45, 46, 47, 48, 49.

Mantle whitish, becoming orange-tinted at the edges, which bear flat, triangular filaments. Foot orange colored above and below, the upper surface densely tubercular, tubercles unequal, each whitish at the summit; tubercular upper surface covered with a brown, mucilaginous epidermis. Length 12–13, width 9–10 cm.; sometimes as large as 19 by 14 cm.

Shell oblong, *extremely depressed*, whitish under a thin yellowish cuticle; apex considerably posterior and to the left, conically projecting and recurved like a *Capulus*, toward the posterior and left margins. *Margins conspicuously undulated;* disk with distinct though *low and wide radial waves*, and some linear grooves; and with concentric growth-striæ or wrinkles. Interior pale yellow or white toward the periphery and on muscle-scar, with the space within the muscle-impression and a ring outside of it rich brown.

Length 5·2; breadth 3·7, alt. ·5 cm.

Length 7·2–7·5, breadth 6·1–6·3 cm.

Entire Mediterranean and Adriatic Seas; from the Ægean to Spain, but rather local; *Atlantic at Cape Verde Is.* ('Talisman' and 'Challenger'); ? *St. Helena* (Smith). Laminarian zone and deeper. Pliocene of Italy; pleistocene of Sicily and Rhodes.

Umbrella mediterranea LAM., An. s. Vert., vi, p. 343; edit. DESH., vii, p. 574.—PHIL., Enum. Moll. Sicil., i, p. 113, pl. 7, f. 11.—DELESSERT, Rec. de Coq., pl. 23, f. 12.—FORBES, Rep. Æg. In-

vert., B. Asso., 1844, p. 134.—Reeve, Conch. Icon., xi, pl. 1, f. 2.—Chenu, Manuel, i, p, 398, f. 3018, 3020.—Kuster, Conchyl. Cab., p. 3, pl. 1, f. 1–4.—Gray, P. Z. S., 1856, p. 46; Figs. Moll. Anim., iv, p. 33; ii, pl. 164, from Deshayes in Cuvier's Regne Anim. Moll., pl. 37.—Hidalgo, Journ. de Conch., 1867, p. 423.—Weinkauff, Conch. des Mittelm., ii, p. 179.—Moquin-Tandon, Ann. Sci. Nat. (5), xiv, 1870, p. 121, pl. 21–28 (anatomy).—Fischer, Journ. de Conch., 1883, p. 3.—Granger, Moll. de France, p. 240, pl. 18, f. 1.—Buq., Dautz. and Dollf., Moll. du Rouss., i, p. 554, pl. 65, f. 1, 2.—Vayssiere, Rech. Zool., Opistobr., p. 134, pl. 6, f. 137–150 (anatomy).—Smith, P. Z. S., 1890, p. 299.—Watson, Chall. Rep. Gastrop., p. 674.—Heymons, Zeitschr. für Wissensch. Zool., lvi, p. 244, pll. 14–16 (Embryology).—*Umbella mediterranea* Delle Chiaje, Memoria, iv, pp. 200, 187, pl. 69, f. 5, 19, 20.—*Patella umbellata* Delle Chiage, pl. 106, f. 26.

Umbrella lamarckiana Recluz, Revue Zoologique, April., 1843, p. 109.—Kuster, Conch. Cab., p. 4, pl. 1, f. 5, 6.

?*Parmophorus patelloideus* Cantraine (see under *Tylodina citrina*).

The shell is more depressed than that of *U. sinicum*, with more undulating edges and more conspicuously recurved apex. A small individual is figured.

U. sinicum Gmelin. Pl. 70, figs. 58, 59, 60; pl. 71, figs. 63, 64, 65; pl. 72, figs. 70, 71.

Shell large, oval, inequilateral, depressed. White under a thin straw-colored cuticle, which is lamellose and brownish toward the periphery. Vertex a small conical yellow boss, behind the middle and decidedly nearer the left side, apex recurved. Disk with growth-lines and numerous very low, unequal radial waves, the margin but slightly undulating. Interior brown and conspicuously radially striate inside the muscle-scar (or in the form from Sandwich Is., orange-brown within muscle-scar, with a yellow halo); white toward the edge.

Length 8·8, breadth 7, alt. 1·1 cm.

Length 10, breadth 8·5, alt. 1·15 cm.

Length 9, breadth 7·1, alt. 1·65 cm. ("aurantium").

Length 9, breadth 7·3, alt. 1·2 cm. ("aurantium").

Patella sinica Gmel., Syst. Nat. (13), p. 3705 (referring to very characteristic figures in Davila and Martini).

Patella umbellata Gmel., Syst. Nat. (13), p. 3720.

Patella umbrella MARTYN, Universal Conch., ii, pl. 102, and in Chenu's reprint, Bibliothèque Conchyliologique, ii, p. 26, pl. 36, f. 1. —"*U. umbrella* Gmel.," DALL, Rep. 'Blake' Gastrop., p. 60.

Acardo umbella LAM., Syst. Anim. s. Vert., p. 130 (1801).

Acardo orbicularis MEG. VON MUHLFELD, Der Gesellschaft Naturforsch. Freunde zu Berlin, Magazin für die neuesten Entdeckungen in der gesammten Naturkunde, v, p. 63 (1811).

Umbraculum chinense SCHUM., Essai d'un Nouv. Syst. Vers Test., p. 178 (1817).

Umbrella indica LAM., Anim. s. Vert., vi, p. 343 (1819).—BLAINVILLE, Malacol., pl. 44, f. 1.—SOWB., Genera of Shells, f. 1, 2.—KRAUSS, Die Südafrik. Moll., p. 62.—REEVE, Conch. Syst., ii, p. 52, pl. 155, f. 1, 2; Conch. Icon., xi, pl. f. 1.—KUSTER, Conchyl. Cab., p. 5, pl. 1, fig. 7 (1862).—EYDOUX & SOULEYET, Voy. de la Bonite, Zool., ii, p. 471, pl. 27, f. 1–12.—MARTENS, in Mobius' Meeresfauna Mauritius, p. 309; Conchol. Mittheil, i, p. 104, pl. 20, f. 4–7 (monstrous specimen figured).—GOULD, U. S. Expl. Exped. Moll., p. 311, pl. 26, f. 408.—*Operculatum indicum* ANGAS, P. Z S., 1867, p. 228, *cf.* PSE., Amer. Journ. Conch., vii, p. 22.

Ombrella indica BLAINV., Man. de Malacol., p. 475, pl. 44, f. 1, 1a, 1b (=*Gastroplax* Blainv., Bull. des Sci. par la Soc. Philomathique de Paris, for 1819, p. 178–182.—*Gastroplax tuberculosus* BLV., Dict. Sci. Nat. xviii, p. 177).—*Umbrella chinensis* GRAY, in M. E. Gray, Figs. Moll. Anim., iv, p. 33, and ii, pl. 163, f. 1, 2 (copies from Blainv. Malacol., pl. 44, f. 1).—*Umbrella indica* GRAY, Figs. Moll. Anim., iv, p. 33, and ii, pl. 163. f. 4, type specimen in B. M. of Blainville's *Gastroplax*, the shell removed. (This specimen also the original of Blainville's figures, Malacologie, pl. 44, f. 1).

Operculatum aurantium PEASE, Amer. Journ. Conch., iii, p. 287, *conf.* GLD., Expl. Exped., p. 312.

The shell of *U. sinicum* is less depressed than that of *U. mediterraneum*, with more numerous, narrower radial waves, less undulating periphery and less strongly hooked apex. It is also larger.

This is the species ordinarily known as *Umbrella indica* Lamarck. There are, however, no less than seven properly proposed specific names by strictly binomial authors, anterior to the date of *indica;* and since the well known name must fall, there seems no reasonable objection to the use of the prior of Gmelin's two specifics. Lamarck's name has held its tenure chiefly because no exposition at all complete of the synonymy of this species has hitherto been published.

The soft parts have been figured by Blainville, Gray, Eydoux and Souleyet, and Gould. The locality of the single alcoholic specimen figured by the first two authors is not known. The figures of the *Bonite* voyage and the U. S. Exploring Expedition were drawn from Sandwich Island examples; and this form Pease proposes to separate specifically from the "*U. indica*" under the name *aurantium*. The characters of the soft parts cited by him are useless, as no adequate information on those of *U. sinicum* is extant, his comparison with the *Bonite* figures being fallacious on account of the fact that those figures were drawn from Sandwich Island specimens. He distinguishes the shells by the less marked radiating ribs and color of the inside, which is "in the center dark chestnut-brown, muscular impression yellowish, bordered by a concentric band of chestnut-brown, outer edge yellowish. Length 5½, diam. 4 inches." The animal "attains the size of 8 inches in length," and when living is orange yellow.

Hawaiian specimens before me differ slightly from typical *U. sinicum* in the obsolescence of the radial ridges externally. The body is more depressed than in specimens of *U. mediterraneum* (judging both by alcoholic examples), the tubercles of the surface are higher, and the mantle edge has fewer, slenderer processes.

Gould describes the Sandwich Island form as covered with prominent tubercles of different sizes, growing smaller toward the margin, cream-colored, with olive shadings in the fissures, increasing toward the margin, branchiæ orange colored.

U. CUMINGI Deshayes. Pl. 73, figs. 86, 87.

Shell large, irregularly patelliform, ovate, the vertex excentral, bent toward the back and left side. White under a corneous, yellowish epidermis, with radiating obtuse angles. Lower surface with the central area subradiated with orange or chestnut, muscle impression narrow, continuous, irregular. Length 120, width 90, alt. 23 mill., or smaller. (*Desh.*).

Island of Bourbon (Maillard).

Umbrella cumingi DH., Moll. de l'Ile Reunion, p. 52, pl. 8, f. 4, 5.

Readily distinguished from *U. indica* by the form and the relative size of the colored middle area within. It is oval, quite regularly obtuse at the ends. Outside covered by a yellowish corneous epidermis, nearly identical with that of *U. indica*. This epidermis

is radiated, the rays being thickened and coarsely scaly. When the epidermis is removed the shell is a beautiful white, and shows ten obtuse angles which radiate from the center toward the periphery, but which are placed at unequal intervals and completely disappear before they reach the circumference. The edges of the shell are thin and sharp. Below in the middle there is a large discoidal area, sometimes of a brownish fawn, sometimes of a paler tint, verging toward orange. This spot is proportionally smaller than in the *U. indica*, and moreover, is *nearly smooth*, not showing the deep radial incisions which characterize that species. In *U. cumingi* this area is definitely bounded by a narrow white zone with irregular contours, representing the muscle impression. Below this impression may be remarked a rather narrow zone, washed with pale fawn; and finally, the rest of the shell is a very pure milk-white. In the smaller and younger individual figured, the shell is transparent enough to show through some of the epidermal rays.

Description and figures from Deshayes. The smooth central area seems to be its most prominent feature.

U. PICTUM A. Adams.

Shell orbiculate-oval, flat, the apex produced, brown, incurved; covered with a thin corneous epidermis, concentrically striated, whitish, radially painted with orange; interior shining, orange at the margin. (*Ad.*).

Lord Hood's Island (Mus. Hasler).

Operculatum pictum A. AD., P. Z. S., 1854, p. 137.

This species is richly painted with reddish-orange, disposed in a radiated manner around the outer margin, the rays extending towards the center; the apex is hooked and more elevated than in the other species. (*Ad.*).

U. CORTICALIS Tate. Pl. 70, fig. 62.

Shell orbicular in outline, moderately elevated, with the apex prominent, somewhat incurved, and a little excentric; covered except apex, with a well developed epidermis, which extends about half as far again as the shell. The epidermis is raised into about 20 broad rays, diverging from the apex, and is concentrically lamellose. It is pellucid white, but encircled with a band of maroon color, corresponding with the edge of the shell; it is very tough, and can be readily removed in one piece.

The shell is of a primrose yellow color, thin, concentrically striated, and with a few obscure radial ridges. The animal is of a deep port-wine colour; the foot is circular in outline, with an extended margin; the under side of the mantle is covered with small white carunculæ.

Dimensions.—Transverse diameters, 19 and 15; height, 4 mill. (*Tate*).

Lower end of the South Channel of Port Phillip, seven to sixteen fathoms, sand and weed (J. B. Wilson); *St. Vincent Gulf, S. Australia.*

Umbrella corticalis TATE, Trans., Proc. and Rep. Roy. Soc. S. Australia, xi, p. 65, pl. 11, f. 11 (April, 1889); Rep. Austr. Asso. Adv. Sc., i, p. 336; and in WILSON, Proc. Roy. Soc. Vict. (new series), ii, p. 66 (1890).

Subgenus HYALOPATINA Dall, 1889.

Hyalopatina DALL, Bull. Mus. Comp. Zool., xviii, p. 61.

Shell dextral, flattened, sculptured, ovate, nucleus sinistral, immersed. Soft parts unknown.

H. RUSHII Dall. Pl. 51, fig. 58 (enlarged).

Shell oval, translucent bluish-white, almost perfectly flat, extremely thin. Nucleus of less than one whorl, half immersed, the remainder rising above the surface, smooth, not polished. Upper surface nearly flat, except near the nucleus which is situated nearly in the median line and close to the posterior margin; concentrically faintly undulated; with faint concentric growth lines, and with very numerous radiating lines of extremely minute slightly elevated points, recalling the granules of *Poromya* on a much finer and more minute scale. They are so small as to hardly appear elevated, but more like radiating lines of opaque dots on the generally translucent surface. Margin regularly ovate, entire, extremely thin. Under surface of shell mostly polished, a little domed under the part in front of the nucleus; there are faint markings (interrupted on the right side about the middle) which appear as if they might represent the area of muscular insertions, but the polish of the shell is such that this is not definitely ascertained. The sides of the shell are a little elevated, as if it had grown on a slightly concave surface, but the ends are depressed about to the same extent (*Dall*).

Length 9·3, width 7·5; posterior margin to nucleus, 1·8 mill.

Off Great Isaac Light, Bahamas, in 30 fms. (Dr. W. H. Rush).

Hyalopatina rushii Dall, Blake Gastrop., p. 61 (1889).

This remarkable shell has been some time in the National Museum, and has been submitted to several conchologists, and studied with much care. In the absence of any further information, I have come to the conclusion that it may be related to *Umbraculum*, from which, conchologically, it is separated by its oval form, posterior nucleus, and granulated surface. The discovery of a living specimen, however, may show the true relations of the creature to be elsewhere. It has a little the general appearance of an extremely thin, flat *Crepidula unguiformis* without a deck, and with the nucleus within the margin (*Dall*).

The figure is from a drawing kindly lent by Dall.

Genus TYLODINA Rafinesque, 1819.

Tylodina Raf., Analyse de la Nature, ou Tabl. de l'Univers et des Corps Organises, 1815, p. 143 (nude name); Journal de Physique, de Chimie, d'Hist. Nat., etc., lxxxix, p. 152 (1819).—*Joannisia* Monterosato, Nomencl. Gen. e Spec. Conch. Médit., p. 149 (1884), type *T. citrina*.

Animal almost completely retractile under the shell; foot flat, broadly truncate in front, pointed behind; head distinct, elongated and sub-bifid in front, with a buccal veil terminating in labial tentacles, the mouth between buccal veil and foot; dorsal tentacles long, cylindrical, slit on the outer sides almost their entire length, with olfactory lamellæ within the slit. Eyes sessile at their interno-anterior bases; mantle completely covered by shell, its edge denticulate. Branchial plume bipinnate, free for the greater part of its length, lying between mantle and foot on the right side, the end projecting backward. Anus behind the gill; genital pore in front of gill.

Radula armed with many similar narrow teeth; jaws rudimentary; gizzard with numerous corneous denticles.

Shell external, conical and limpet-like, calcareous except at the borders which are membranous; apex recurved, when perfect composed of two glossy, vitreous whorls, coiled spirally to the left and backward.

Distribution: Mediterranean, Gulf of Mexico, California.

This genus differs notably from *Umbraculum* in having the shell larger in proportion to the body, in the projecting head, not included in an anterior sinus of the foot, and in the external genitalia.

T. CITRINA Joannis. Pl. 73, figs. 77, 78, 79, 80, 81, 82, 83.

Shell short-oval, low-conic, rather thin; apex subcentral, directed slightly backward and to the left; surface smooth, showing slight growth lines under the lens, a peripheral zone 3 or 4 mill. wide is membranaceous and squamose. Color pale yellowish, deeper toward the apex, with a variable number (6 to 22) of red-brown radial bands, coloring the cuticle, unevenly spaced, sometimes part of them disposed in pairs; apex whitish. The dark rays do not reach the apex, and are entirely epidermal, worn shells not showing them.

Length 20, breadth 15, alt. 4 mill.

Soft parts citron-yellow throughout, with slightly paler bands on upper surface of the foot; gill pale yellow. Gizzard armed with a multitude of corneous, lamellose denticles. Jaws represented by fleshy prominences on each side of the mouth, covered with a transparent chitinous cuticle. Radula with the formula 80 to 130.1.80 to 130; usually about 90.1.90.

Bay of Athens (Joannis); *Palermo and Catania, Sicily* (Arad. & Ben.); *Sardinia* (Cantraine); *St. Helena* (Smith); *Lancerotte, Canaries* (McAndrew).

Tylodina citrina JOANNIS, Mag. de Zool., 1834, pl. 36, f. 1–5.—WEINKAUFF, Conch. des Mittelm. p. 178.—ARAD. & BEN., Conch. viv. Mar. Sicilia, p. 123.—MONTS., Nuova Rivista Conch. Médit., p. 49.—KOBELT, Prod. Faun. Moll. Eur., p. 273.—*Tylodina* (*Joannisia*) *citrina* MONTS., Nomencl. Gen. e Spec. Conch. Méd., p. 149.—VAYSSIERE, Ann. Sci. Nat. (6), xv, 1883, p. 28, pl. 2, 3, f. 22–35; Recherches Zool., Opistobr., p. 152, pl. 5, f. 130–136.—SMITH, P. Z. S., 1890, p. 299.—*T. punctulata* Raf., GRAY, P. Z. S., 1856, p. 46.

? *Parmophorus patelloideus* CANTRAINE, Bull. Acad. Brux., ii, p. 395.—*Umbrella patelloidea* CANTR., Malac. Médit. et. Lit., p. 93 [pl. 8, f. 19?].

?*Tylodina punctulata* RAFINESQUE, Journ. de Physique, de Chimie, d'Hist. Nat., etc., lxxxix, 1819, p. 153.

?*T. atlantica* GRAY, P. Z. S., 1856, p. 46="*Umbrella* (small)," MCANDREW, Ann. Mag. Nat. Hist. (2), x, p. 104.

The shell is larger and more depressed than in *T. rafinesquii* Phil.

It is uncertain which species of *Tylodina* was known to Rafinesque. His description is as follows:

"Genre 5. TYLODINA. (Mollusque). Corps rampant, à petite coquille dorsale extérieure membraneuse, sans spire, oval, à pointe

calleuse, patelliforme, 4 tentacules, les 2 postérieurs éloignés et plus grands, branchies dorsales sous la coquille à droit, anus à la droit du cou. *T. punctulata* pointillé de brun, tentacules obtus; coquille lisse."

Gray's *T. atlantica*, collected by McAndrew at Canary Is. (erroneously said by Gray to be from Madeira), is thus described: "Shell solid, bright yellow; periostraca —?"

Parmophorus patelloideus Cantraine has also been referred to *Umbraculum mediterraneum*, young; but I do not know that Cantraine's type has been compared with either that species or the present one.

T. RAFINESQUII Philippi. Pl. 73, figs. 84, 85.

Shell elevated-conical, rounded-ovate, white, but covered by a yellowish cuticle; smooth, showing but slight growth-lines.

Length 10, breadth 8⅔, alt. 6 mill.

Catania and Palermo, Sicily (Phil., Arad. & Ben.); *Adria-Zara* (Brusina); *Algeria* (Weinkauff), in laminarian and coralline zones.

Tylodina rafinesquii PHIL., Enum. Moll. Sicil., i, p. 114, pl. 7, f. 8*a*, *b* (1836); ii, p. 89.—ARADAS & BENOIT, Conchigliologia viv. mar. della Sicilia, p. 122.—MONTEROSATO, Nuova Rivista Conch. Medit., p. 49.—*T. raffinesquei* Phil., WEINKAUFF, Conch. Mittelm., ii. p. 178.—*T. citrina* LOCARD, Coq. Mar. des Cotes de France, 1892, p. 18, f. 4.

The shell of this species is rounder and more elevated than that of *T. citrina*.

T. DEUBENII Loven.

Shell ovate, depressed-conic, obsoletely angulate-radiate, with nearly two sinistral nuclear whorls at the recurved apex. Animal oblong, the head without a rostrum, deeply slit in front into lanceolate lobes; with ear-shaped vibracula; gill on the right side, the subtubular anus behind it; foot strong, thick, the sole ovate. Color of animal and epidermis purple, 10·7 by 8·5 mill.

Coast of Norway.

T. duebenii LOVEN, Ind. Moll. lit. Scand. occ., p. 19.

This unfigured species is mentioned by Sars (Moll. Reg. Arct. Norv. p. 363), but no additional information has been published so so far as I can find.

T. AMERICANA Dall. Pl. 50, figs. 47, 48.

Shell rounded in front, subtruncate behind; thin, translucent yellowish, with a tint of orange near its apex; surface polished but irregularly malleated as if from irregularities of station; apex disproportionately pointed compared with the rest of the shell, erect, dwindling rapidly to a blunted point with a slight posterior tendency; on the back of this is apparently an obscure scar as of a dehiscent embryonal tip or nucleus; apex about the beginning of the posterior third; interior polished, anterior horns of the pedal muscles reaching about the anterior third united by a delicate arched line marking the attachment of the mantle. Length 10, width 8, alt. 4 mill. (*Dall*).

In my Report on the "Blake" Gasteropods I have described and figured a shell, which, in the absence of the soft parts, I was obliged to refer doubtfully to the young of *Umbraculum* or *Tylodina*, under the head of "*Umbraculum bermudense* Mörch?"

This shell now proves to be a genuine *Tylodina*, different from the species of the Mediterranean or of California, and which may take the name of *T. americana*. The shell, which was well figured as above, in life has a membranous extension 3–5 mill. wide around the margin, continuous with the epidermis. The latter is smooth and pale with radiating broad purplish rays of color. The animal is much smaller than that of *T. Rafinesqui* in proportion to the shell, which abundantly covers it, and it emits a dark purple dye. It does not seem to differ essentially in the superficial characters of its soft parts from the species of the Mediterranean, which, however, has not been very well figured. The gill is attached to the edge of mantle on the right side. The other characters are much as stated in H. & A. Adams' generic description. (*Dall*).

Off *Havana*, dead, in 80 fathoms ('Blake'); *northern border of the Gulf of Mexico* (U. S. Fish Commission at Station 2406), in 26 fathoms, coarse sand and broken coral, on the line between the mouth of the Mississippi River and Cedar Keys, Florida; living.

Umbraculum bermudense (Mörch?), DALL, 'Blake' Gastropoda, Bull. M. C. Z., xviii, p. 60, pl. 14, f. 9, 10 (1889).—*Tylodina americana* DALL, Nautilus, iii, p. 121 (March, 1890).

T. FUNGINA Gabb.

Shell subelliptical, elevated, the apex subcentral, blunt; cuticle reddish-brown, yellowish on and near the apex, projecting beyond

the margins of the shell. Interior straw yellow, shading toward the margin into a bluish-white. Length 1·3, width 1·1, alt. ·5 inch. (*Gabb.*).

Santa Barbara Island, California, on the shore (Dr. Cooper).

Tylodina (*?*) *fungina* Gabb, Proc. Cal. Acad. Sci., iii, p. 188 (1865).

Soft parts unknown. The above measurements are approximate, making allowance for the epidermis which in the dry specimen is contracted and incurved around the margins to a width of about a tenth of an inch. A single specimen, fresh, though without the animal, was found by Dr. Cooper. (*Gabb*).

Tylodina excentrica Locard=*Gadinia*.

Insufficiently known or spurious species.

Genus *Bertinia* Jousseaume, 1883.

Bertinia Jouss., Bull. Soc. Zool. France for 1883, 3d. pt., p. 194 (type *B. bertinia* Jouss., l. c., pl. 10, f. 6, 8).

Shell calcareous, limpet-like, oval, with thin edges and subcentral summit inclined toward the shorter end of shell, which is nail-shaped, with muscular impression within. Soft part unknown. (*Jouss.*).

This shell must have much resemblance to a worn *Helcioniscus toreuma* or *nigrolineatus* (see Manual, vol. xiii, p. 135), with the periphery broken down to the muscle impression, and with the outside worn. Can the learned Doctor have been deceived?

B. bertinia Jouss. (Pl. 71, figs. 68, 69). Shell ovate-oblong, patelliform, convex outside, the vertex excentric, bent toward the anterior side; white and nail-shaped in front, with an impressed muscle scar; the anterior surface, as well as the lateral notches, smooth and shining, colored yellowish-brown toward the summit, nacreous white toward the borders, as if the anterior part had been buried in the tissues of the animal nearly to the apex, while behind it was joined at the edges only. Posteriorly rounded and smooth, with fine lamellose growth-lines toward the summit, a little swollen and shining; its color of a yellow-orange white, is masked toward the summit by a wide spot of deep brown, which emits rays nearly to the periphery of the same color, more or less long, and quite widely spaced. The interior, which is concave, smooth, shining

and of a faience white in front, is marbled behind by irregularly disposed interrupted and entangled orange bands. In certain individuals some of these bands are a more or less deep brown. The edges of the shell, very thin, sharp and lamellose, are of such fragility that none of the specimens have it completely intact.

Japan.

The substance of Jousseaume's description is given above. He examined four specimens.

Family PLEUROBRANCHIDÆ.

Tectibranchiata Notaspidea in which the gill-plume arises about the middle of the right side and extends backward, the dorsal shield is fleshy, stiffened by spicules, and either shell-less, or concealing wholly or mainly a delicate Haliotiform shell, the radula is multiserial, without rachidian teeth, and the jaws are well developed, composed of many oblong plates arranged in tessellated pattern; rhinophores present.

The group is allied to the *Umbraculidæ*, but differs externally in the want of a patelliform shell, the posterior gill, etc. It is not closely allied to *Runcinidæ*, which may be considered a specialized and ancient branch of the *Notaspidia*, divergent in its reduction of the radula to a triserial arrangement, and the loss of rhinophores by degeneration.

Pleurobranchidæ are world-wide in distribution in tropical and temperate (rarely in cold) seas. There are many species, especially of the genus *Pleurobranchus;* and the really diagnostic characters of a large number of them are not yet known.

Attention should be directed especially to certain characters, which have been very generally neglected, but are essential to any thorough systematic knowledge of species of the group. These features are the following: (1) Positions and space-relations of the genital orifices. (2) Number of leaflets or plumules of gill, length of its adnate and free portions, and smooth or tuberculate nature of the rachis. (3) Shape and denticulation of the individual plates of the jaws. (4) Denticulation of the teeth of the radula.

Characters (3) and (4) are readily observed with low powers of the microscope; no delicate manipulation being called for. With adequate knowledge of the above-mentioned points, and with what is already known of the animals, there would be but little difficulty in constructing "keys" or tables for the easy identification of spec-

imens either living or alcoholic. Without these data, which are supplied in very few except the European species, nothing can be done toward this end. No monograph of the family has hitherto been published. The shells of a few species have been figured in the Conchologia Iconica; and Vayssière and Bergh have supplied admirable anatomical details of the structure of the European species.

Synopsis of Genera and Subgenera.

I. Mantle with the edge free and overhanging on all sides; rhinophores close together, inserted below anterior edge of mantle on a frontal veil (*Pleurobranchinæ*).

a. Shell wholly immersed in the closed mantle.

b. Penis or its foramen close to female orifice, PLEUROBRANCHUS, p. 191.

bb. Penis or penial foramen some distance in front of female orifice, mantle generally notched in front or behind, OSCANIUS, p. 212.

aa. Shell partly exposed by an orifice in the mantle, GYMNOTOPLAX, p. 210.

II. Mantle passing without boundary into the broad anterior veil, the rhinophores far apart, inserted on the surface of united mantle and veil; no shell, (*Pleurobranchœinæ*).

a. Right, left and posterior borders of mantle freely projecting, separated from the foot by a groove, KOONSIA, p. 221.

aa. Posterior and left borders of mantle passing directly into the integument of the foot, not free or projecting, PLEUROBRANCHÆA, p. 223.

b. Buccal rostrum when projected very large; veil of moderate size *Pleurobranchœa.*

bb. Buccal rostrum slender; body orbicular, the veil very large, crescentic *Euselenops.*

III. Genus HALIOTINELLA (p. 209) is not included in the above synopsis, as its characters are unknown. The shell is similar to that of *Pleurobranchus.*

Genus PLEUROBRANCHUS Cuvier, 1804.

Pleurobranchus CUV., Ann. du Mus. d'Hist. Nat., v, p. 275.—*Berthella* BLAINVILLE, Dict. Sci. Nat., xxxxi, p. 370, 1826, for *B. porosa=plumula.*—*Cleantus* LEACH, Synops. Moll. Gt. Brit., p.

28, 1852, for *C. montagui=plumula.*—*Cleanthus* Leach, 1819, GRAY, P. Z. S., 1847, p. 163.—? *Westernia* and *Gervisia* Quoy & Gaim., *Ms.* according to de Blainville, Man. de Malac., Addit. et Correct., p. 654, 1827.—? *Discoides* RENIERI, (? Tav. Class., 1807) according to Agassiz, Nomencl. Zool.

Body oval, the mantle about the size of the foot, free and projecting at the edges all around; the rhinophores contiguous, inserted below it, above an expansion of the integument or "veil." Gill bipinnate; male and female generative orifices contiguous or almost united. Shell present, auriculate. Type *P. peronii*, Cuvier.

In this genus, which comprises a majority of the species of the family, the mantle is smooth or at least not conspicuously tubercular, the rhinophores are inserted below the front edge of the mantle, and the genital orifices are closer together than in other *Tectibranchiata*. The internal classification of the group is still unsettled, awaiting more light; but the following arrangement may be suggested:

I. Shell completely buried in the closed mantle.

a. Male and female genital orifices contiguous but distinct, Section *Pleurobranchus.*

aa. Male and female orifices united in a single elongated papilla or pit Section *Berthella.*

It is at present impossible to make any more logical arrangement than a geographic one of the species of this group. So many species are still known only in the most superficial way, that there is no basis upon which to build a synoptical table or "key" for their determination. It is known that all European species belong to *Berthella;* most Indo-Pacific forms upon which data are extant, belong to the restricted group *Pleurobranchus.*

Geographic distribution of species.

European Seas: *P. plumula*, Atlantic.
P. stellatus, aurantiacus, monterosatoi, perforatus, brevifrons, Mediterranean.

American: *P. areolatus, quadridens, circularis,* West Indies.
P. patagonicus, S.-E. coast Argentina.
P. digueti, Lower California.

Polynesian: *P. delicatus, ovalis, pellucidus, tessellatus, marginatus, rufus, varians.*

Australo-Zealandic: *P. punctatus, angasi,* Australia.
P. ornatus, New Zealand.
East Indian: *P. cornutus,* Amboyna.
Indian Ocean: *P. peronii,* Mauritius.
P. granulatus, Cape of Good Hope.
P. oblongus, citrinus, Red Sea.
P. zeylanicus, Ceylon.

(*Species of European Seas*).

P. PLUMULA Montagu. Pl. 52, figs. 60, 61, 64, 65; pl. 74, figs. 1–3.

Body semioval, gelatinous, lemon color, or whitish with a slight tinge of yellow, marked with flake-white spots, minutely tessellated all over with faint lines, and covered with a few scattered pustules; mantle extending on every side beyond the foot, of a reticulated and apparently porous texture, and occasionally puckered or raised in folds; it is rather thin on the back and thickened at its edges, which are often wavy and wrinkled; and it has a small notch on the right hand side, as in Lamellaria; the edges of the mantle are irregularly studded with microscopic tubercles; head-veil or hood semicircular, forming a bluntly pointed flap at each side, it is carried in advance of the foot; head short, mouth round and open; tentacles proportionally large, but rather short, diverging at an angle of about 45° and projecting outwards, they are half open down the middle; tips obliquely truncated, eyes black, partly imbedded in the outer integument and not always visible, placed close together on the neck between the tentacles at their base; foot oblong, expanded towards the sides, and sinuous or wavy at the edges, occupying about half the space of the mouth; it is squarish or gently curved and double-edged in front, and tapers to a rounded point behind; gill plume placed in the divisional groove between the mantle and foot, not always protruded, and never beyond the edge of the mantle, composed of about 20 sloping strands or pectinations; it is in some individuals reddish-brown, and in others of the same color as the rest of the body; liver brown; ovary cream color. Length 1 inch.

Shell oval with a squarish outline, sometimes oblong, more solid and compact than *P. membranaceus,* glossy and partially iridescent; sculpture, microscopic and close set longitudinal striæ, which are more conspicuous near the spire, and are interrupted by the lines of growth, so as to form a series of short rows; the lines of growth are irregular and rather numerous, and many specimens have also a

slight furrow which runs obliquely from back to front; color pale reddish-brown or tawny, rarely milk-white; spire extremely small but distinct, twisted sideways, and placed at a short distance from the inner margin at the posterior or smaller end; it consists of two whorls, the first of which is tubercular and somewhat prominent; mouth open throughout; dorsal margin gently curved, flat, slightly reflected and thickened; inner margin short; ventral margin long and nearly straight. Length ·6, breadth ·325 inch. (*Jeffreys*).

English and Irish Coasts, under stones at low water, sometimes deeper; *Norway; the Channel, and Ocean Coast of France.*

Bulla plumula Mont., Test. Brit., i, p. 214, pl. 15, f. 9, and vign. 2, f. 5 (1803).—*Pleurobranchus plumula* Forbes & Hanley, Hist. Br. Moll., iii, p. 559, pl. 114F, f. 6, 7; pl. xx, f. 1, 2.—Jeffreys, Brit. Conch., v, p. 11, pl. 1, f. 2.—Sowerby, Conch. Icon., xvii, f. 1. —Sars, Moll. Reg. Arct. Norv., p. 363, pl. xiii, f. 1 (jaws and dentition).—*P. sideralis* Loven, *teste* Jeffreys.—*Berthella porosa* Leach, Blainville, Dict. Sci. Nat., xxxxi, p. 370 (1826); Man. de Malac., p. 470, pl. 43, f. 1.—*Pleurobranchus plumulatus* Mont., Locard, Prodr. Mal. Fr., in Ann. Soc. d'Agric. Lyon (5), viii, 1885, p. 69 (1886).—*Pl. fleuriausi* d'Orbigny, Voy. dans l'Amér. Mérid., p. 205, foot-note.—*Cleantus montagui* Leach, Synops. Moll. Gt. Brit., 1852, p. 28.

This species is type of *Berthella* Blainv. It differs from the Mediterranean form (*stellatus*) in having the plates of the jaws finely denticulate (pl. 74, fig. 1), and the lateral teeth smooth (pl. 74, figs. 2, 3). There are also more branches on the gill, and the shell is apparently more quadrate.

A variety *alba* Marshall (Journ. of Conch., Leeds, vii, p. 265) has been proposed for specimens from Jersey with the shell pure white. Fifty per cent. from that locality are stated to be white.

P. stellatus Risso. Pl. 52, figs. 62, 63; pl. 74, figs. 95, 96.

Body oblong, ovoid, the teguments of very delicate consistence, general color transparent yellow. Mantle thick, very large, more vividly colored than the rest of the animal, and very slightly emarginate in front; under a strong lens showing a multitude of dots of deeper color. Foot small, oval, and wholly covered by the mantle. Gill pinnate, folded longitudinally, composed of 15 pinnules on each side of the rachis. Orifices of genitalia united in a sort of cloaca, and placed in front of the insertion of the gill. Anus behind gill-insertion. Length 29, width 20 mill.

Jaws composed of lozenge-shaped pieces, each terminating in a single denticle (pl. 74, fig. 96). Radula with the formula 150.0.150, the lateral teeth bearing 8 to 10 small denticles immediately below the terminal hook (pl. 74, fig. 95).

Shell haliotiform, quite strong, translucent and iridescent; spire little projecting; color amber yellow; under the microscope a close pattern of longitudinal wrinkles is visible (fig. 63); these giving the iridescent effect.

Alt. 8, diam. 5 mill.; alt. 7, diam. 4 mill. (*Vayssière*).

Adriatic and Mediterranean Seas, laminarian and coralline zones; *St. Lucie, Cape Verde Is.* (Bouvier); *Strait between Pico and Fayal, Azores*, 130 meters (Hirondelle).

Pleurobranchus stellatus Risso, Hist. Nat. Eur. Mérid., iv, p. 41 (1826).—Rochebr., Nouv. Arch. du Mus., 1881, p. 264.

Pleurobranchus ocellatus Delle Chiaje, Memorie, Atlas, pl. 104, f. 9, 16 (1828).

P. plumula Vayssiere, Journ. de Conch., 1880, p. 208, pl. 7, f. 2 (shell); Rech. Moll. Opistobr., Tectibranches, p. 113, f. 105–107 (teeth and jaws).—Monterosato, Journ. de Conch., 1874, p. 281.—Bergh, Camp. Sci. Albert I, fasc. iv, p. 19, pl. 2, f. 43–50; pl. 3, f. 51–67; and ? ? Bull. Mus. Comp. Zool. xxv, no. 10, p. 197, pl. 9, f. 12–14; pl. 10, f. 1–8 (from Lower California!). Not *P. plumula* Mont.

Lamellaria kleciachi Brusina, Contr. Faun. Dalm., p. 35 (1866).

I retain the Mediterranean form separate from that of northern Europe mainly on account of the great differences in jaws and dentition. In this species the elements of the jaw have a median point but no lateral denticles, and the lateral teeth have numerous short denticles below the terminal hooklet. In *P. plumula*, as figured by Sars, the plates of the jaw are multidenticulate, and the lateral teeth apparently lack denticulation. There are also some differences in the shells and gills between the two forms.

The synonymy given is merely tentative.

P. aurantiacus Risso. Pl. 52, figs. 76, 77, 78, 79, 80.

Body ovoid; general color transparent orange, sometimes bright orange; tissues very delicate. Mantle small, not covering either buccal veil, rhinophores or end of the foot. Foot nearly twice as long and as wide as the mantle. Gill pinnate, folded longitudinally, quite long and with 16 or 17 pinnules on each side. Genital orifices and anus as usual in the subgenus.

Length 31, breadth 17 mill.

Jaws composed of pieces having five denticles on each side of the terminal point (pl. 74, fig. 99). Radula with formula 70.0.70, the lateral teeth with terminal hooklet but no denticles below it (fig. 97, group of median teeth; fig. 98, a large lateral).

Shell auriculate, the spire a little projecting; solid, thick but transparent, of a dull amber-yellow color.

Alt. 11, diam. 7 mill. (*Vays.*).

Nice (Risso), *Gulf of Marseilles* (Vayssière); *Strait between Pico and Fayal, Azores*, in 130 meters (Hirondelle).

Pleurobranchus aurantiacus Risso (Cuvier, Regne Anim., ii, p. 396, name only), Journ. de Phys. Chim., Hist. Nat., lxxxvii, p. 374 (1818); Hist. Nat. Eur. Mérid., iv, p. 40, pl. 1, f. 8.—Phil., Enum. Moll. Sicil., ii, p. 85, pl. 20, f. 7.—Guerin, Mag. de Zool., 1830, p. 18, pl. 18.—Vayssiere, Journ. de Conch., 1880, p. 206, pl. 7, f. 1 (shell); Recherches, etc., p. 115, f. 102–104 (jaws and teeth).—Bergh, Rés. Camp. Sci. Albert I, fasc. iv, p. 26, pl. 3, f. 68–70, 75; pl. 4, f. 76–79.—Monts., Nuova Rivista, p. 48.—Lacaze-Duthiers, Ann. Sci. Nat., xi, 1859, p. 199, pll. 6–12 (anatomy).—Cantraine, Malac. Médit. et Litt., p. 90, pl. 4, f. 7.—*P. elongatus* Cantraine, Bull. Roy. Soc. Brux., ii, p. 385.

The foot is larger than in *P. plumula;* there are fewer denticles on the plates of the jaws. The shell is solid, calcareous, and proportionally larger than in any other species except *P. membranaceus*, compared to the size of the animal. It is also distinguished by the deep orange color of the soft parts.

P. monterosatoi Vayssière. Pl. 52, figs. 66, 67, 68; pl. 74, fig. 6.

Body elliptical, oval, swollen; general color rosy ochre-yellow. Mantle covering the whole body and emarginate in front, of a deeper ochre tint, with large light spots and numerous ochre-brown or grayish dots. Buccal veil triangular, the two tubular dorsal tentacles carried at its base. Foot occupying the entire length of the mantle, but a little narrower than the latter. Gill pinnate, folded longitudinally, quite long and bearing 24 to 25 pinnules on each side. Genital cloaca in front of gill insertion, anus behind.

Length 55, width 40 mill.

Jaws composed of chitinous pieces, each with a strong angular denticle, without lateral denticles (fig. 6). Radula with the formula 80.0.80; lateral teeth all alike in form, with a terminal hook but no denticles below it, as in *P. aurantiacus.*

Shell elongated, but little convex, the spire projecting; growth-striæ quite apparent; color white (sometimes slightly amber), iridescent, translucent, calcareous and quite solid.

Alt. 12, diam. 5 mill. (*Vayssière*).

Gulf of Marseilles (Vayssière).

Pleurobranchus monterosatoi VAYSSIERE, Journ. de Conch., 1880, p. 212, pl. 7, f. 5; Recherches, etc., p. 118, pl. 4, f. 108–112.—BERGH, Rés. Camp. Sci. Albert I, fasc. iv, pl. 3, f. 71–74.

The colors are due to tiny pale ochreous or whitish grains in the integument near the surface, massed together to form the markings. The spire of the shell is longer than in other Mediterranean species. Smaller specimens of the shell measure 5 mill. long, slightly over 2 wide; and the length of the whole animal varies from 30 to 55 mill.

P. PERFORATUS Philippi. Pl. 52, figs. 73, 74, 75.

Body ovate-elliptical, convex; mantle retuse in front, convex behind, obsoletely warty at the sides, and as if perforated all over with numerous deeply impressed points; foot equalling the mantle; gill arising at the middle of body, extending nearly to the tip of tail, and adnate for $\frac{3}{4}$ of its length. Shell large, $\frac{3}{4}$ the length of body. Length $13\frac{1}{2}$, width $8\frac{1}{2}$, alt. $6\frac{1}{2}$ lines.

Catania, Sicily.

P. perforatus PHIL., Enum. Moll. Sicil., ii, p. 87, pl. 21, f. 2, (1844).

Described from an alcoholic specimen which had lost every trace of color. The comparatively large and very thin shell (broken in the type), the adnate gill and punctate mantle, should render it identifiable, although it has not been recognized by later authors.

P. BREVIFRONS Philippi. Pl. 52, figs. 69, 70, 71, 72.

Mantle ovate, 7 lines long, $5\frac{1}{2}$ wide, rounded in front and behind, semiglobose, very smooth. Foot much narrower, but longer than mantle; shell large, thin, oblong, $5\frac{1}{2}$ lines long, scarcely over 3 wide; gill small. Foot violaceous, verging toward reddish; mantle margin and tentacles sprinkled with violaceous. (*Phil.*).

Sicily.

P. brevifrons PHIL., Enum. Moll. Sicil., ii, p. 87, pl. 20, f. 5, (1844).

Described from an alcoholic specimen.

Insufficiently described Mediterranean species of Pleurobranchus.

P. savii Verany. Body oval, compressed, "color nankino." Mantle a little smaller than the foot, marbled with white and chocolate. Tentacles and shell covered with ferruginous points; margin of the foot tending to orange; gill a little longer than mantle, of a clear azure color. Length 45, width 32 lines. Riviera di Ponente.

(*Verany*, Catal. Anim. Invert. Mar. del Golfo Genova e Nizza, 1846, pp. 16, 19).

P. limacoides Forbes. P. corpore (repente) oblongo, lævi aurantiaco; pallio ovato, plano, contra-subemarginato; cauda exserta lanceolata; tentaculis elongatis, linearibus. Long. 2¾ inch. Under stones near water-mark among the Cyclades. Allied to *P. oblongus* of Cantraine (*Forbes*, Rep. Ægean Invert., Rep. Brit. Asso. Adv. Sci., 1843, p. 187 (1844).

P. calyptræoides Forbes. P. corpore, ovato, lævi, citrino, pallio orbiculari convexo, cauda exserta lata obtusa, tentaculis linearibus. Long. 1¼ inch. On sponges, 20 fms., Cervi Bay, Morea (*Forbes, l. c.*).

P. scutatus Forbes. P. corpore rotundato, rubro-aurantiaco; pallio lato scabro, convexo, antice producto; cauda pallio occulta; tentaculis linearibus. Long. 1 inch. On *Codium tomentosum*, in 20 fms., Cyclades (*Forbes, l. c.*).

P. sordidus Forbes. P. corpore rotundato, convexo; pallio rugoso, sordide brunneo, antice producto; pede quadrato, albo; cauda brevissima; tentaculis albis linearibus; ore aurantiaco. Long. ¾ inch. 40 fms., off Paros (*Forbes, l. c.*).

(*American species*).

P. QUADRIDENS Mörch.

Body with the mantle inflated, soft, oval; veil transverse, produced laterally, slit in angles at each side; foot angulate, without an anterior sulcus. Tentacles flattened, deeply slit, intorted; gill plume rather short, with about 20 somewhat remote pinnæ on each side. Living animal bright orange, the young cinnabar colored.

Lingual teeth long, slender, lightly arcuate, apex uncinate, incurved, with 3 approximated teeth, of which the two smaller inferior ones are equal.

Shell subopaque, pellucid, elongated, straight-sided, lightly rounded in front, the dorsal margin suddenly reflexed and winged behind; right back margin obtusely angled; whorls 2, spire mamillate, prominent; suture impressed toward the aperture, margin incised; submembranous growth-striæ regular, growth-sulci remote, interstices iridescent with frequent splendid dots; radial striæ very obsolete, radial impression sublateral; length 5, width 3 mill.

St. Thomas, West Indies on corals in 3–4 ft. (Riise); *also Guadeloupe.*

Pleurobranchus voisin du Pleurobranche orangé Desh., Journ. de Conch., 1857, p. 142.—? *Pleurobranchus sp.*, Rang, Manuel, pl. iii, f. 4.—*Berthella quadridens* Morch, Journ. de Conch., 1863, p. 29.

The number of leaflets on gill is more numerous than in *Pl. aurantiacus* Risso, and the two species are readily distinguished by the lingual teeth. In *P. quadridens* there are three denticulations on the recurved cusp, the two lower being smaller and equal, while in *P. aurantiacus* there are ten little and nearly equal digitations at the point.

Mörch's reference to Rang for an illustration, is only one of his jests. See also *Haliotinella patinaria* Guppy.

P. areolatus Mörch.

Body soft, nearly prismatic, suboval, gibbous from contraction; mantle suboval, rectangularly emarginate in front, back areolate, the areas oblong-hexagons, central ones rather smooth, those at sides smaller with a median wart, anterior marginal areas small, obsolete, but with very distinct papillæ. Foot oval, the margin thin, undulated, anterior sulcus of foot gaping, laterally much reduced, sole narrowed behind, with a longitudinal sulcus glandulose on each side nearly one-third the length of foot. Veil above the mouth transverse, narrow, with subacute, slit lateral angles, the bases of the sides reticulated with small confluent purple spots. Tentacles with circular sulci, approximate, cylindrical, rolled, slit down the side and perforate at apices. Eyes large and black, midway between bases of tentacles and the mantle. Gill plume long, triangular, the sides subparallel, with about 16 alternating secondary plumes on each side, becoming smaller toward the apex, each with a strong wart at the base. Length 21, width 16, alt. 15 mill. in the contracted condition.

Lingual teeth simple, not denticulate, the shape of a horse's jaw, rather acute at apices, lightly bent. Shell small, elongated, nearly flat, with a linear, radial, submedian impression; liræ of growth strong and remote, the interstices a little concave, lirulæ of growth solitary, small. Color chestnut, whitish toward the periphery; length 6 mill. (*Morch*).

St. Thomas, West Indies (Riise).

Pleurobranchus areolatus Morch, Journ. de Conchyl., 1863, p. 28; Malak. Bl., xxii, p. 178.

This may, perhaps, be an *Oscanius*.

P. circularis Mörch.

Mantle circular, gelatinous, white or pale isabelline, subpellucid; periphery thick, semiterete, margin prone, inflexed, acute, the edge submembranous-circular; foot elongate-oval, margin undulating, with very short, transverse remote sulci; anteriorly broadly rounded, sinuous in the middle, destitute of the transverse sulci of the fore part, rather acute behind, with an oblique, funnel-shaped sulcus, slightly glandular. Veil lunar-reniform, slit at sides. Tentacles approximate at bases, diverging, acute, incurved, conic, slit along the sides; eyes situated below their external bases, inconspicuous, deeply sunken. Gill plume adherent for its entire length, the rachis smooth with 16 alternating plumules on each side. Anus in front of end of plume. Shell small, median, white, seen through the transparent mantle.

Diam. mantle 31 mill.; length of foot 25, width 12½; width of veil 10, length in middle 3 mill.

St. Thomas, West Indies (Riise).

Berthella circularis Morch, Journ. de Conch., 1863, p. 31.

This species and the preceding are known only by Mörch's descriptions.

P. patagonicus d'Orbigny. Pl. 74, figs. 92, 93.

Body quadrilateral, depressed, amber colored, of a deeper tint in the middle of the mantle, paler on gills and soles. Mantle oblong, rounded at the ends, narrower than the foot, entirely smooth, the edges thin and sharp, not covering the gill. Foot squarish, very wide, extending beyond mantle all around, its edges thin. Head moderate, rounded, without buccal appendages. Tentacles 2, flat and somewhat channelled. Gill conic. Genital orifice forming a

large pad in front of the gill, the male organ projecting from the front of the orifice. Length 20, width 15 mill.

Shell noticeably chalky, with thin corneous edges, contained in the interior of the mantle, depressed, nearly smooth, reddish-yellow, oval, growing obliquely as in other species; length 8 mill. (*Orb.*).

Coast of Ensenada de Ros, 41° S. Lat., east coast of Argentina, under large stones at low water (*Orb.*).

P. patagonicus ORBIGNY, Voy. dans l'Amér. Mérid., p. 204, pl. 17, f. 4, 5.

Differs from other described species in the large size and quadrangular shape of the foot, and small extent of the mantle.

P. DIGUETI Rochebrune. Pl. 54, figs. 98, 99, 1, 2.

Body rounded, ovate, swollen; mantle ovate, subtruncate in front, the margins waved, wide; foot rather narrow, circularly crenulated, buccal region proboscis-like; tentacles 2, round and channelled; gills somewhat concealed; scarlet above, buff-white below. Length 22, width 16, alt. 12 mill. (*Rochebr.*).

Mogote, Bay of La Paz, Lower California (Diguet).

Pleurobranchus digueti ROCHEBR., Bull. Mus. d'Hist. Nat., 1895, p. 240.

Differs from *P. patagonicus* d'Orb. by its oval, rounded and not quadrilateral body; narrow foot, not extending beyond the other parts of body; by the proboscis-like, not rounded head, round instead of flattened tentacles, the partly covered gill not passing beyond the edge of the mantle, and by its coloration. (*Rochebrune*).

A specimen collected at La Paz by Mr. W. K. Fisher, and presented to the Academy by W. N. Lockington, seems to belong to this species. It is illustrated on pl. 54, figs. 98, 99, 1, 2, and may be described as follows:

Color, after long immersion in alcohol, dirty light gray, bluish over the viscera. Dorsal integument warty, the warts small, separated, appearing as if planted in little pits. Mantle wider than foot, amply projecting on all sides. Eyes behind bases of rhinophores, under the mantle. Rhinophores close together, short, blunt, cylindric and slit as usual; below them a trilobed anterior disk around the mouth. Foot longer than body, with the forward margin duplicated. Gill folded, adnate, except for a short free tip, with about 20 bipinnate plumules on each side, alternating on the rachis which bears a tubercle at the insertion of each plumule.

Anus behind posterior insertion of gill. Genitalia in front of anterior insertion, male and female organs contiguous. Total length of body 26, width 18 or more, alt. 11 mill.

Shell small, situated entirely in front of the middle of body, nearly flat, calcareous and moderately strong, purplish-white. Earlier portion convex, terminating in a minute spiral, later portion becoming flattened, with flaring margins. Surface closely wrinkle-striate. Interior concave above, with deep, coarse, concentric wrinkles. Alt. 5·2, width 4 mill.

Jaws large, component plates of the tessellation without trace of lateral denticulation. Teeth of the radula simply hooked, with no denticles.

(*Polynesian species*).

P. DELICATUS Pease. Pl. 45, figs. 7, 8, 9.

Shell small, rather solid, subpyriform, elongate, narrow posteriorly, rounded in front, slightly flexuous; surface rough and marked with prominent lines of growth; nucleus spiral; anterior portion stained with violet, posteriorly white or light horn color.

Animal delicate, subpellucid, mantle smooth, oblong-oval, rounded at both extremities, convex along the dorsal region. Foot elongate-oval, rounded at both ends, entirely concealed by the mantle. Tentacles slightly tapering to truncate tips. Oral veil somewhat concave in front, produced laterally in tentacular form. Branchial plume small, short.

Color uniform orange-yellow throughout, the viscera imparting a dark shade to the dorsal region. (*Pse.*).

Huahine, under stones at low water mark (Pse.).

P. delicatus PSE., P. Z. S., 1861, p. 245; Amer. Journ. Conch., iv, p. 79, pl. 9, f. 1.

The shell of this species (and of a few others to be hereafter described) differs considerably from the usual form in being very narrow posteriorly, approaching that of genus *Syphonota*. (*Pse.*).

P. OVALIS Pease. Pl. 46, figs. 16, 11, 17.

Animal oblong-oval, smooth, subpellucid, convexly rounded above, thin at the margins, rounded behind, slightly concave in front. Foot oblong, nearly as wide as the mantle, and projecting far posterior to the body. Tentacles well developed, smooth, scarcely tapering, cylindrical, truncate and involute. Eyes black

and immersed just behind the tentacles. Oral veil large, notched in front, and extended laterally in tentacular shape. Branchial plume free, on the posterior half of right side, plumules tripinnate. Length two inches.

Cream color, irregularly spotted, both as to shape and size, with purple-red. A few similar spots on the head, veil and gill. Mantle and foot narrowly edged, and extremities of the tentacles tinted with the same color. (*Pse.*).

Tahiti, under stones, in upper region of laminarian zone (Pse.).

P. ovalis Pse., Amer. Journ. Conch., iv, 79, pl. 9, f. 3 (1868).

The shell is very fragile. We have but an imperfect specimen, which is of the usual shape and size. (*Pse.*).

P. TESSELLATUS Pease. Pl. 47, figs. 20, 21.

Animal oval, subpellucid, smooth, white reticulations on upper surface of the mantle, slightly raised. Mantle rounded behind, slightly concave in front. Foot thin, oblong, projecting a short distance behind the mantle when the animal is in motion. Oral veil subtriangular, somewhat produced laterally. Cream color, mantle reticulated with opaque white, and irregularly spotted with reddish-brown, the larger spots more or less dotted with white, under edges of the mantle and margin of foot dotted with reddish-brown, and a larger spot of same color on the upper posterior end of the foot. Shell ? (*Pse.*).

Polynesia.

P. ——— *?* Pse., P. Z. S., 1861, p. 245.—*P. tessellatus* Pse., P. Z. S., 1863, p. 510; Amer. Journ. Conch., iv, p. 80, pl. 9, f. 4.

No locality is given by Pease for this species.

P. PELLUCIDUS Pease.

Mantle oval, smooth, convex above, not covering the foot behind, and the margins slightly undulated. Tentacles short, stout, smooth, truncated and grooved. Oral veil large, broad, emarginated in the front, which part is much prolonged laterally, so as to give it a triangular form. Eyes sessile, immersed at the posterior inner bases of the tentacles. Foot large. Branchiæ on the right side, tripinnate, elongate and exposed. Color whitish translucent, and the whole upper surface of the mantle, with the exception of that portion covering the shell, minutely reticulated. Shell rather large, oblong-ovate, whitish horn color, thin, fragile, pellucid, and rather

more obtusely rounded before than behind. Surface above convex, and coarsely marked with concentric wrinkles; nucleus posterior and lateral, forming a small cavity at that portion of the shell.

Length 5 lines (*Pse.*).

Sandwich Is. (Pse.)

Pleurobranchus pellucidus Pse., P. Z. S., 1860, p. 24.

P. MARGINATUS Pease.

Form oval, smooth, convex above and subpellucid. Mantle widest at the middle, rounded behind and truncately rounded in front, and concealing the foot. Tentacles rather long, stout, grooved, truncated, and cylindrical. Oral veil triangular. Foot oblong oval. Color pale lemon yellow, freckled with white and margined with light red. Shell ovate, thin, fragile, pellucid, whitish horn-color, with a dull red tinge near the nucleus. Nucleus subspiral. Striæ of growth coarse. (*Pse.*).

Sandwich Is. Under stones in the lower region of the littoral zone (*Pse.*).

P. marginatus Pse., P. Z. S., 1860, p. 25, No. 18.

P. RUFUS Pease.

Form oval, smooth and convex above. Mantle concealing the foot, widest at the middle, rounded behind, and somewhat concave in front. Tentacles stout, truncated, grooved and cylindrically tapering. Oral veil subtriangular. Branchiæ tripinnate, with the pinnae arranged alternately. Foot oblong oval, rounded at both ends. Color uniform vermilion. Length 1 inch. (*Pse.*).

Sandwich Is. Under stones in the lower region of littoral zone.

P. rufus Pse., P. Z. S., 1860, p. 25, No. 19.

P. VARIANS Pease.

Oval, rather rugose, convex above. Mantle rounded behind, deeply sinuose in front, and margins slightly undulated. Tentacles arising from the head, curving laterally, deeply grooved below, truncated, cylindrically tapering, transversely lamellated. Eyes at their posterior bases. Oral veil large, convex in front, and much dilating laterally, where it is deeply grooved. Mouth proboscidiform. Branchial plume simple, pinnate on the middle of the right side. Foot large, reaching the edge of the mantle laterally and behind. Color varying; some bright red, others lemon-yellow, or purplish brown, others again variegated with whitish; beneath

paler than above. Shell on the anterior half of the body, concealed, small, fragile, pellucid, oblong ovate, convex and ornamented with wrinkles of growth. Nucleus posterior, more or less brownish. (*Pse.*).

Sandwich Is. (Pse.)

P. varians Pse., P. Z. S., 1860, p. 25, No. 20.

(*Australo-Zealandic Species.*)

P. PUNCTATUS Quoy & Gaimard. Pl. 45, figs. 2, 3, 4, 5, 6.

Body elongated ordinarily flat above, rounded at the two ends, wider behind. Mantle covering the foot to the edges, but the foot projects behind. Entire body smooth, of a beautiful orange, with two lateral series of white dots above; tentacles and produced angles of veil have a deeper orange longitudinal line; foot with a groove of lighter tint in front. The viscera are visible through the integument both above and below, as a brown spot. Veil wide, arcuate, terminating in two obtuse points; tentacles proportionally very long. Length 1 to 2 inches. The figures represent it in various positions.

Port Jervis, Australia, 9–10 fms.

Pleurobranchus punctatus Quoy & Gaimard, Zool. Astrolabe, ii, p. 299, pl. 22, f. 15–19 (1832).

P. ANGASI Smith. Pl. 46, figs. 12, 13.

Animal (in spirit) uniformly pale buff, elongate ovate. Mantle probably smooth in life, wrinkled by contraction, not very widely produced at the free margin. Foot broad, tapering behind, roundly subtruncate in front, where there is a thickening forming a double margin beneath the proboscis. The frontal veil is straight in front, angular at the sides, which are grooved. Tentacles shortish, slit at the outer side, with the minute eye-specks at their base behind. Branchial plume consisting of about sixteen leaflets. Penis spine-like, very acute, and slightly curved at the tip.

Shell placed well forward, the pale apex being posterior. It is brown in front, glossy, and beautifully iridescent on the exterior. It consists of about a whorl and a half, the nucleus being spiral and hollow within. The last whorl is much prolonged by additional strongly defined concentric layers, and also ornamented with fine, yet distinct transverse striæ. The columella is arcuate, and has an umbilical groove parallel with it.

Length of animal 17 mill., diam. 7; length of shell, from nucleus to opposite end, 4½. (*Smith*).

Port Jackson (Coppinger).

Pleurobranchus angasi E. A. Smith, Zool. Coll. "Alert," p. 88, pl. 6, f. *K* (1884).

This may be the *P. delicatus* of Pease, but there appear to be certain differences in the shells of the two forms which may be of specific value. (*Sm.*).

P. ornatus Cheeseman. Pl. 47, figs. 22, 23.

Body 3–4 inches long, broadly elliptical, depressed, nearly equally rounded at both ends, color varying from pale buff to a clear reddish brown, with irregularly disposed blotches of a rich, dark red-brown; mantle large, extending over and concealing both head and foot, quite smooth, margin thin, entire; dorsal tentacles short, stout, abruptly truncate, finely transversely wrinkled, approximate at their origin, but gradually diverging at their apices; color reddish-brown tipped with white; eye-specks black, placed a little distance behind the tentacles, embedded in the integument, but appearing through it; oral tentacles united in front by a thin semicircular expansion which forms a veil concealing the mouth, and which is carried in advance of the foot; mouth roundish, with fleshy lips; buccal plates two, regularly reticulated; odontophore with numerous rows of similar unciform teeth. Branchial plume placed in the groove between the foot and the mantle, very large, composed of about 22–24 pectinations; foot oblong, thin and flexible, pale waxy white.

Shell internal ½ to ¾ inch long, squarish oblong, thin and membranous, semitransparent, slightly iridescent, closely marked with somewhat irregular concentric striæ or folds; color varying from nearly white to pale pinkish or tawny brown. Spire minute, obscure, mouth occupying the whole of the under surface (*Cheesem.*).

Auckland Harbor, New Zealand, under stones between tide marks; *also near Waiwera and in Hauraki Gulf* (Cheeseman).

Pleurobranchus ornatus Cheesem., P. Z. S., 1878, p. 275, pl. 15, f. 1, 2.—Hutton, Man. N. Z. Moll., p. 124.

(*East Indian and Indian Ocean Species*).

P. cornutus Quoy & Gaimard. Pl. 23, figs. 28, 29, 30, 31, 32.

A very small, ovate species, remarkable for the strong anterior sinus of the dorsal shield, out of which the two tentacles pass. The left tentacle is longer, but this seems to be accidental. The veil forms two diverging horn-like processes; mouth projecting, foot sur-

passing the mantle behind, somewhat pointed. The mantle is a little raised behind to form a gutter below. Entire body reddish, covered with violaceous tubercles which are slightly yellowish; a brown band borders the upper surface of the foot. Labial tentacles long. Length not over 10 lines.

Amboyna.

P. cornutus Q. & G., Zool. Astrol., ii, p. 298, pl. 22, f. 20–24.

Quoy & Gaimard remark that the individual described seems to be young.

P. PERONII Cuvier. Pl. 48, figs. 24, 25, 26, 27, 28; pl. 74. figs. 88, 89, 90.

Living animal oval, convex, the mantle notched in front, shorter than the foot behind; closely covered with round, low tubercles, each on a red ground is bounded by a ring of deep crimson lake, with a dot in the middle (see fig. 28, enlarged). The sides of the foot are also dotted with this color. Veil slightly bilobed; eyes distinct. Shell very delicate and thin. Length 2 to 3 inches.

In alcohol the red color changes to a yellowish tint, and the relative proportions of foot and mantle are different, the foot becoming smaller; tuberculation of mantle obsolete.

Port Louis, Mauritius.

Pleurobranchus peronii CUVIER, Ann. du Mus. d'Hist. Nat., v, pp. 275, 266, pl. 18, f. 1–6 (1804).—QUOY & GAIMARD, Voy. de l'Astrol. Zool., ii, p. 296, pl. 22, f. 7–10.—DESH. in Cuvier's Règne Animal, Moll., p. 88, pl. 32, f. 1, *a–i*.—MARTENS in Möbius' Meeresfauna Mauritius, p. 309.—SOWERBY in Conch. Icon., xvii, f. 2.

Quoy & Gaimard declare the species described from life by them (see above) to be undoubtedly the same as that upon which Cuvier established the genus. The latter was much contracted in alcohol and had changed in color and form. An alcoholic specimen is shown in figs. 88, 89, 90 of plate 74, the figures being copies of Cuvier's original illustration of *P. peronii*.

The figures of Deshayes, cited above, are perhaps not referable to this species.

Möbius thus describes the specimens found by him in Fouquets Bay, Mauritius: Dark purple-red, the back lighter in the middle, the mantle with low rounded warts throughout; sole also dark purple-red, but somewhat bluish. Shell likewise of a beautiful purple-

red color, very small, 4 mill. long, 3 wide in an example, the mantle of which, in spirits, measures 25 mill. long, 16 wide; in life 50 long, 30 wide. In the spirit examples the warts of the mantle are more intense red than their interstices.

P. GRANULATUS Krauss.

Alcoholic specimen: Body small, ovate-oblong, convex, soft, granulate above; mantle entire, the ends rounded; head-shield dilated, truncate, slightly horned at the sides, tentacles shorter. Foot emarginate behind, extending backward about as far as the mantle; color? Gill delicate, 3 lines long. Length of animal 8 lines.

Shell situated in the middle of the mantle, calcareous, elongated and narrow, with distinct growth-striæ and a little spire at the summit. Length 1·7, breadth 0·5 lines. (*Krauss*).

False Bay, Cape of Good Hope (Wahlberg).

Pleurobranchus granulatus KRAUSS, Die Südafrik. Moll., p. 61, (1848).

P. OBLONGUS Audouin. Pl. 49, figs. 39, 40, 41.

Body oblong, the length slightly exceeding twice the width, rounded at the two ends, very convex above. Length 29, alt. 12 mill. Shell elongated, somewhat triangular.

Red Sea?

SAVIGNY, Descr. de l'Egypte Gastrop., pl. III, f. 1.—*Pleurobranchus oblongus* AUD., Expliq. des planches de Savigny, Descr. de l'Egypte, ed. 2, Vol. xxii, p. 140 (1827).—ISSEL, Malac. Mar Rosso, p. 163.

This species is based on Savigny's figures copied on my plate. It is presumably from the Red Sea, but this is not positively known; it may possibly be Mediterranean. Vayssière places it as a doubtful synonym under his *Pl. monterosatoi*. Cantraine (Malac. Médit. et Lit., p. 90) identifies with *oblongus* an Adriatic form found by him, but states that he doubts their identity because his species has the back absolutely smooth, while Savigny's figures seem to show it warty. Moreover, the genital apertures are different from known Mediterranean species.

P. CITRINUS Rüppell & Leuckart. Pl. 48, figs. 29, 30, 31.

Alcoholic specimens: Pale citron-yellow, marbled with irregular whitish spots on the back of the mantle. Mantle entire and rounded

behind like the foot, borders of mantle and foot not projecting beyond each other. Penis not visible externally. Small black eyes at bases of the tentacles; tentacles blunt in front. Gill with 23–25 branches. Length one inch.

Shell lying in about the middle of the back under the mantle, but a little toward the right over the gill; very small but relatively thick, calcareous, narrow and white behind, wider and reddish-brown in front, resembling the shell of Pinna in respect to contour. Consists of united layers. Length 2 lines. (*R. & L.*).

Gulf of Suez, on the shore; collected in February.

Pleurobranchus citrinus R. & L., Atlas zu der Reise im Nördlichen Afrika von Eduard Rüppell, Neue Wirbellose Thiere des Rothen Meeres, p. 20, pl. 5, f. 1 (1828).—Ehrenberg, Symb. Phys. Decas 1, No. 1.—Issel, Mal. Mar Rosso, p. 162.—?Sowerby in Reeve, Conch. Icon., xvii, pl. 1, f. 7.—Probably not *P. citrinus?* Kelaart, Ann. Mag. Nat. Hist. (3), iii, p. 495.

Sowerby gives a figure of the shell, said to be copied; but he misquotes Rüppell's page and figure, and there is no illustration of the shell in Rüppell's work.

P. zeylanicus Kelaart. *Unfigured.*

Pale yellow, splashed with darker yellow and brown, and minutely spotted with rusty brown. About 2 inches long. (*Kel.*).

Back Bay, Ceylon (Kel.).

Pleurobranchus zeylanicus Kel., Ann. Mag. Nat. Hist. (3), iii, p. 495 (1859); Journ. Ceylon Branch Roy. Asiat. Soc., iii, pt. 1, p. 111 (1883).

?Genus Haliotinella Souverbie, 1875.

Shell umbilicated, auriform, with an epidermis, thin, much depressed; spire posterior, very short, many whorled; whorls few, the last very ample, forming the greater part of the shell; aperture very large, the margins not joined, left margin inflexed below, reflexed at the columellar insertion; soft parts unknown. (*Souv.*).

The genus was provisionally placed by Souverbie in the vicinity of *Sigaretus*. Mörch declares it to be based on a *Pleurobranchus* shell; and Fisher locates it with doubt in *Pleurobranchidæ*. I am disposed to agree with the view expressed by Mörch.

H. MONTROUZIERI Souverbie. Pl. 71, figs. 66, 67.

Shell umbilicated, ovate-oblong, testacella-shaped, very thin, fragile, much depressed; apex flat, subsinistral; white, pellucid, covered by a thin straw-colored epidermis. Whorls 4, separated by a depressed suture, rapidly increasing, the earlier 3 rounded, last very ample, planulate, forming nearly the whole shell, concentrically subplicate-striate. Aperture elongate-oval, very large, shining within, the margins separated; right margin acute, left margin arcuate, incurved toward the right, channelled outside above, vaultingly reflexed over the small umbilicus at the insertion, and connected with right margin by a callus. Length 14, width 7, alt. 2½ mill. Aperture 13½ mill. long, 5 wide. (*Souv.*).

Island of Art, New Caledonia (Montrouzier).

Haliotinella montrouzieri SOUV., Journ. de Conchyl., 1875, p. 33, pl. 4, f. 1.—*Cf.* Mörch, J. de C., 1876, p. 374.

H. PATINARIA Guppy. Pl. 72, figs. 75, 76.

Shell lengthened-auriform, flat, subtranslucent, rather thin, concentrically striated, whitish; spire very short. Whorls 4, the earlier 3 forming the spire, last whorl very ample. Aperture long-ovate, the margins separated, right margin somewhat incurved, flexuous, left margin prominent, acute, grooved outside above at the umbilical fissure. (*Guppy*).

St. Christophor (*St. Kitts*), *West Indies.*

Haliotinella patinaria GUPPY, Journal de Conch., 1876, p. 163; Journ. de Conch., 1878, p. 322, pl. 10, f. 1. Compare Mörch, J. de C., 1876, p. 374.

Mörch considers this the shell of *Pleurobranchus quadridens.*

Genus GYMNOTOPLAX Pilsbry, 1896.

Similar, so far as known, to *Pleurobranchus*, but the mantle is partly open or perforate above, exposing part of the shell. This condition occurs in no other *Pleurobranchidæ.*

G. AMERICANUS Verrill. Pl. 74, fig. 91.

In alcohol the body is oblong, higher than wide, with the mantle extending over the greater part of the shell. The foot is large, thick, with short, rounded, grooved auricles in front, its lateral surfaces, like those of the mantle, covered with small projecting spicules. Head bluntly rounded, with two broad, leaf-like oral tentacles and

two smaller and narrower posterior tentacles, which are flattened and folded; on the left side there is a conspicuous dark blue eye behind the base of the dorsal tentacle, but on the right side the eye is concealed or wanting in our specimen. The gill occupies the groove below the mantle on the right side, and is nearly one-third the length of the shell; just in front of the gill there is a low rounded prominence with a central orifice. The shell is thin, translucent, pale yellowish-white, oblong, with the sides nearly parallel and the anterior end bluntly rounded. The spire is a little prominent, terminal and strongly curved to the left, with the nucleus smooth, glassy and incurved, situated at some distance from the margin. The surface of the shell is covered with numerous strong, irregular, concentric undulations, and by much smaller and finer lines of growth, which are crossed by microscopic, interrupted, radiating lines, giving a very finely reticulated appearance. Length of the shell 13·5, breadth 8·5 mill. (*Verrill*).

Off Martha's Vineyard, 250 fms. (U. S. Fish Comm.).

Pleurobranchus americanus V., Trans. Conn. Acad., vi, p. 429, pl. 44, f. 13 (April, 1885).

G. MARTENSI Pilsbry, n. n. Pl. 48, figs. 34, 35.

Mantle deeply incised in front, projecting beyond the foot all around, the margin thickened and somewhat ragged, evenly and finely granose all over, yellowish-brown, with round spots of dark purple-brown, much scattered, more numerous near the periphery and at the circumference of the part of the mantle covering the shell. Tentacles and angles of the head dark purple-brown. Gill extending along nearly the entire hind half of the right side. Length of living animal 18 mill.; of alcoholic specimen 10; breadth 7½ mill., the foot 6 long, 3½ wide; gill 2½ long.

Shell comparatively very large, elongated, oval, flat, thin and pale reddish, with the apex curved toward the right, and growth-striæ strong. Length of shell 6, breadth 2½ mill. (*Mart.*).

Fouquets, Mauritius (Möbius).

Pleurobranchus scutatus MTS., in Möbius' Meeresfauna Mauritius, p. 309, pl. 21, f. 8 (1880). Not *P. scutatus* Forbes, 1844.

This apparently new species resembles *Berthella porosa* Blainv. (see Gray, Figs. Moll. Anim., pl. 43, f. 1) in aspect, but is distinguished by the deep anterior cleft in the mantle. It is remarkable that the smaller species of *Pleurobranchus* have, as a rule, relatively

larger shells than the larger species. May it not be that the young animals have the shell relatively or perhaps absolutely larger than the adults, so that the young, especially when they differ also in coloration, have been hitherto considered separate species? The degeneration of the shell during the life of the individual is well known to occur in the Nudibranchs, to a still greater extent. (*Martens*).

Genus OSCANIUS Leach, 1847.

Oscanius Leach (in Gray, P. Z. S., 1847, p. 163, *L. membranacea* Mont.) Synopsis Moll. Gt. Brit., pp. 28, 29 (1852), type *O. argentatus* = *tuberculatus* Meckel.—Vayssiere, Rech. Moll. Opistobr., Tectibranches, p. 121 (Ann. du Mus. d'Hist. Nat. Marseille, Zool., ii, 1885).—*Susania* Gray, Guide Syst. Dist. Moll. B. M., pt. 1, 1857, p. 202 (based on *O. testudinarius* and *O. reticulatus*).

Pleurobranchidæ with the body oval, convex, the mantle of the same shape, covering all or a considerable part of the upper surface, projecting and overhanging on all sides, more or less distinctly notched in front or behind or both; gill bipinnate, the rachis tuberculate. Female generative orifice in front of the gill-insertion, the male orifice or penis more anterior, separated from it by some distance. Shell as in *Pleurobranchus*, wholly concealed in the closed mantle, sometimes wanting. Type *O. tuberculatus* Meckel.

Oscanius includes a few large species, in which the mantle is generally tuberculate and sinused in front and at the rear, the gill-stem is nodose, and the penis separated from the female orifice by a considerable space; the latter being the most important character of the group.

The anatomy of the European species has been ably worked out by Vayssière. A number of Indo-Pacific species are herein referred to this genus, and the synonymy of the Mediterranean forms is now for the first time elucidated.

Geographic Distribution of Oscanius.

European: *O. tuberculatus*, *O. testudinarius*.
Indo-Pacific: *O. marinus*, Red Sea.
O. mamillatus, Mauritius.
O. grandis, Huahine.
O. blainvillii, Tahiti.
O. violaceus, Sandwich Is.
Australian: *O. hilli*, New South Wales.

The above species are apparently distinct and well-characterized; a number of others, *O. purpureus*, *O. dilatipes* and *O. reticulatus* are of doubtful status.

O. TESTUDINARIUS Cantraine. Pl. 50, figs. 43, 44, 45, 46.

Body elliptical, globulose, of an ochre red color. Mantle very large, thick, elliptical, with a sinus in front; its whole surface bearing large polygonal tubercles, which, in the middle region of the back, each occupy a mesh of a rose-carmine network; mantle of deeper color than the rest of the body. Foot of the same form as mantle, but smaller, having a gland on the posterior-median part of sole. Gill free its entire length, very long, bipinnate, with a score of pinnules on each side of the nodose rachis. Anus behind the insertion of gill. Genital orifices distinct, situated in front of the gill, the penis a little anterior to the female orifice, and protected by two triangular membranes; renal pore near the female orifice. Large individuals measure, length 19 cm., breadth 14 cm. Jaws lamellose, slightly reniform, composed of little pieces each with 9–11 denticles in front. Radula having the formula 180 to 200.0.180 to 200; teeth hooked, without denticulation.

Shell auriculiform, very small, convex, with a slightly projecting spire and well-marked striæ of growth, quite solid in consistence, pale amber colored. Length 6, width 3 mill.

Gulf of Naples (Delle Chiaje, Cantraine, Philippi); *Messina* (Cantraine); *Palermo* (Monts.); *Gulf of Marseilles*, in 25 to 40 meters (Vayssière).

Pleurobranchus tuberculatus Delle Chiaje, Memorie su la Storia e Notomia degli Animali senza Vertebre del Regno di Napoli, iii, 1828, p. 154, pl. 40, figs. 1–10.—*Pleurobranchus tuberculatus* Meck., Cantraine, Malac. Méd. et Litt., p. 89 (not of Meckel, 1808).—*R. forskahli* Delle Chiaje, *t. c.*, p. 154, pl. 41, fig. 11 (not of Rüppell & Leuckart, 1828).—*Pleurobranchus mammillatus* Schultz, Philippi, Enum. Moll. Sicil., i, 1836, p. 112 (not of Quoy and Gaimard, 1834).—*Pleurobranchus testudinarius* Cantraine, Bull. de l'Acad. Roy. des Sciences et Belles-Lettres de Bruxelles, No. 11, December, 1835, p. 385 (1836); Malacol. Méd. et Litt., p. 88.—Philippi, Enum. Moll. Sicil., ii, p. 86, pl. 20, f. 1; pl. 21, f. 1.—Fischer, Man. de Conchyl., p. 571, fig. 335 (copied from Philippi).—Vayssiere, Journ. de Conchyl., 1880, p. 209, pl. 7, f.

3, 3*a* (shell).—MONTEROSATO, Nuova Rivista Conch. Méd., p. 48.—*Susania testudinaria* Cantr., MONTEROSATO, Nom. Gen. e Spec. Conch. Méd., p. 149.—*Oscanius tuberculatus* Delle Chiaje, VAYSSIERE, Rech. Moll. Opistobr., Tectibranches, p. 125, pl. 5, figs. 113–121 (anatomy).

This is the largest species of the genus, attaining a length of 16 to 19 centimeters. The shell is more oblong and more swollen than in other species of *Pleurobranchus*, and is, in proportion to the size of the animal, much smaller.

The specific nomenclature is unusually involved, but the name proposed by Cantraine seems to be the earliest having a clear title to acceptation.

O. TUBERCULATUS Meckel. Pl. 51, figs. 50 to 57.

Body oblong, the general tint ochrey red. Mantle not very thick, with irregularly scattered, unequal tubercles, which are never nearly so large as in *O. testudinarius;* mantle rounded, emarginate in front, dark red with light spots, not as large as the foot. Foot voluminous, projecting all around the mantle, with a deep sinus in front, and a gland on the posterior median part of the sole. Gill covered by the mantle, folded longitudinally, quite long, with 23–34 alternating pinnules on each side of the tuberculate rachis. Anus behind the insertion of gill. Genital orifices and renal pore in front of it; penis provided with two large triangular membranes.

Length 12, width 11 centimeters.

Jaws with the appearance of being carved, composed of small chitinous pieces, each terminating in a denticle, on each side of which there is one, sometimes two, smaller denticles. Radula with the formula 80.0.80, the inner 25 teeth having an external denticle below the terminal hook, which disappears on the outer teeth.

Shell very large, occupying the greater part of the length of the mantle, quite convex, membranous, with growth lines, and of an iridescent vinous-red color; length of large shells 43, width 29 mill., or, in ordinary specimens, 25 to 30 by 13 to 15 mill.

Mediterranean Sea: Gulf of Marseilles, in 30 to 70 meters (Vayssière); *Algiers* (Joly & Monts.); *Naples* (Tiberi); *Adriatic Sea at Trieste* (Stossich); *Atlantic Coast of France; Southern England and Ireland.* Laminarian and Coralline zones.

Pleurobranchus tuberculatus MECKEL, Beyträge zur vergleichenden Anatomie, i, pp. 33, 26, pl. 38, f. 33–37, 40 (1808).—PHILIPPI,

Enum. Moll. Sicil., ii, p. 87 (1844). Not *P. tuberculatus* of delle Chiaje, Cantraine, Vayssière, and some other writers, which is *O. testudinarius*.

Lamellaria membranacea MONT., Trans. Linn. Soc., xi, 1811, p. 184, pl. 12, f. 4.—*Pleurobranchus membranaceus* FLEMING, Brit. Anim., 1828, p. 291.—FORBES & HANLEY, Hist. Brit. Moll., iii, p. 558, pl. 114 F, f. 5; pl. XX, f. 3.—SOWERBY, Genera of Shells, figs.; Illustr. Index Brit. Sh., pl. 20, f. 29.—JEFFREYS, Brit. Conch., v, p. 10, pl. 97, f. 3.—GRANGER, Moll. de France, 1885, p. 239, pl. 17, f. 34.—BUQ., DAUTZ. & DOLLF., Moll. du Rouss., i, p. 551, pl. 65, f. 3.—SOWB., Conch. Icon., xvii, f. 4.—VAYSSIERE, Journal de Conch., 1880, p. 211, pl. 7, f. 4, 4a (shell).—MONTEROSATO, Journ. de Conch., 1878, p. 320.—*Oscanius membranaceus* Mont., ADAMS, Gen. Rec. Moll., ii, p. 39, pl. 60, f. 5*b*.—CHENU, Manuel de Conch., i, p. 397, f. 3012.—VAYSSIERE, Rech. Moll. Opistobr., Tectibranches, p. 122, pl. 4, figs. 96–101 (anatomy).

Pleurobranchus Lesueur [sic] BLAINVILLE, Manuel de Malacologie, p. 470, pl. 43, f. 2, 2*a* (1825–1827); cited as *P. Lesueurii* by Philippi.—*P. Lesuerii* BLAINVILLE, Dict. Sci. Nat., xxxxi, p. 371 (1826).

Pleurobranchus de Haanii CANTRAINE, Malac. Méd. et Litt., Mém. de l'Acad. Roy. Bruxelles, xiii, p. 89, pl. 4, figs. 6, 6*a* (1840). *Conf.* MONTS., Journ. de Conchyl., 1878, p. 320, p. 160 (*"deshaanii"*). —*P. haanii* LOCARD, Prodr. Mal. France, in Ann. Soc. Agric. Lyon, 1885, p. 70.

Oscanius argentatus LEACH, Synops. Moll. Gt. Brit., p. 29.—*Pleurobranchus denotarisii* VERANY, Catalogo degli Anim. Invert. Marini del Golfo di Genova e Nizza (estratta dalla Guida di Genova), pp. 16, 19 (1846).—*P. contarinii* VERANY, *l. c.*

The mantle bears much smaller tubercles than in *O. testudinarius*, and is of less extent than the foot; and the membranous shell, which is well known in collections, is much larger in proportion to the size of the mantle than in the other species.

The specific name proposed by Meckel must stand for this species, although it has been dropped for over half a century. His description and figures are unmistakable.

Var. *dehaanii* Cantraine. See pl. 51, figs. 54, 55.

According to Monterosato, the *P. dehaani* of Cantraine is distinct in the shell, which is more solid, more convex, and of a more

bronzed color. These may perhaps be features of immaturity. It occurs commonly at Palermo.

O. DILATIPES H. & A. Adams. Pl. 54, figs. 4, 5.

Pale red, with deep red-brown depressed lines, and light pink tubercles surrounded by dark red-brown zones; the foot is flesh-colored, with faint concentric striæ (*H. & A. Ad.*).

Habitat unknown.

Oscanius dilatipes ADS., Gen. Rec. Moll., ii, p. 39, pl. 60, f. 5, 5*a*.

Described without locality from a spirit specimen in Cuming's collection. Seems near *O. tuberculatus* Meckel.

O. RETICULATUS Rang. Pl. 49, figs. 36, 37, 38.

Body oval-oblong, convex, smooth, obtuse in front, subacute behind. Flesh colored, the shade deeper on the mantle, where there are, especially toward the borders, numerous rounded, slightly nebulous black spots of varying sizes, and a reticulation of fine white irregular lines. Mantle with a median sinus in front; eyes at the posterior bases of the tentacles, which are brown, long, swollen at the distal third, and regularly striated transversely. Foot large, oval, pale. Gill transparent yellow. Length 7½ cm.

Shell small, oblong quadrangular, concave below, convex above; right and anterior borders thin, left border thickened and terminating in a small, distinct spiral of 1½ whorls (fig. 37); regularly striated, of corneous texture, reddish below, bluish above. Length 7 mill.

"*Ile du Prieur, dans la baie de Saint-Antoine*" (Rang).

Pleurobranchus reticulatus RANG, Mag. de Zool., 1832, Classe v, pl. 1.

I do not known the locality given by Rang. Perhaps it is San Antonio Bay, Prince's Island, W. Africa, or San Antonio de Praia, Annobom Island.

Kelaart has very briefly described a "*P. reticulatus?*, Gmel." from Trincomalee. See Ann. Mag. N. H., (3), iii, p. 495.

O. MARINUS Forskal. Pl. 48, figs. 32, 33.

Color dark violet, with two (or three) interrupted longitudinal series of entirely white, lunate curved, narrow lines on each side of the back, each series consisting of 4 or 5 such lines. The mouth can be protruded trunk or snout like, the snout being yellowish. Over the mouth there is an expansion of the integument, or labial

tentacle on each side. The gill consists of 22–24 leaflets; in front of it is the genital opening, forward of which lies the aperture of the penis, which projects, having a peculiar wing-like expansion on its posterior projecting part. Foot in front and at the sides at least as wide as the mantle, and behind it projects in a blunt angle. Tentacles slit down the outer side, cylindrical and hollow. Eyes lying at the base of tentacles, in the slit, so that they may be covered by its free edges. There is a deep incision in the back border of the mantle.

Shell small, rounded, membranous and transparent, thin, simple and smooth, not composed of layers.

Living animal, length 5 to 6 inches. In alcohol contracting to 3 to 3½ inches, 2 to 2½ inches broad.

Massaua W. side of the Red Sea, collected on corals in January (Rüppell.).

Lepus marinus Forskal, Icones rerum naturalium quas in Itinere Orientali depingi curavit Petrus Forskal, p. 9 (name only, referring to) plate 28, fig. A (1776).—*Pleurobranchus forskalii* Ruppell & Leuckart, Atlas zu der Reise in N. Afrika, Neue wirbellose Thiere, p. 18, pl. 5. f. 2 (1828).—*Pleurobranchus ruppellii* Issel, Malac. Mar Rosso, p. 162 (1869). Not *Pleurobranchus forskahli* Delle Chiage, Memoire, iii, p. 154 (November, 1828)= *Oscanius tuberculatus* var.

Forskal has given a characteristic illustration of this large and peculiar species, although in his posthumous work no description is given. Moreover, he uses the old pre-Linnæan formula "*Lepus marinus*" for the animal, in his explanation of plates. There is an objection, however, to the use of Rüppell and Leuckart's name *P. forskali,* on account of the fact that it bears even date with Delle Chiaje's similar name for another species. Under these circumstances I consider that stability of the name will be best conserved by reverting to the earliest, rather than by adopting Issel's proposed change.

The following form is evidently nearly allied, probably identical.

O. purpureus Kelaart. *Unfigured.*

Deep reddish-purple. Mantle very dark purple, and spotted with still darker purple. There is a bright-white zigzag line on each side of the back of some large specimens. Length nearly 6 inches; 4

inches broad. The young is of a lighter purple, and may be mistaken for another species. (*Kel.*).

Trincomalee, Ceylon, in deep water (Kelaart).

Pleurobranchus purpureus KEL., Ann. Mag. N. H., (3), iii, p. 495; Journ. Ceyl. Branch Roy. Asiatic Soc., iii, p. 111, for 1856–1858.

O. VIOLACEUS Pease.

Oval, convex above, and covered with crowded depressed granules, with multiangular bases. Mantle rounded behind and deeply sinuated in front, and repand, rather thin and undulated along the lateral margins. Tentacles arising from the lateral anterior portion of the head, approximating at their bases, stout, large, truncated, slightly swollen, transversely laminated, grooved in front. Eyes sessile, conspicuous at their posterior bases. Mouth proboscidiform. Veil large, granose above, triangular, and grooved laterally. Branchial plume single, simple, pinnate, on the middle of the right side, free half of its length, along the middle of the plume two rows of alternate granules. Foot large, oval, reaching the margins of the mantle laterally and projecting a little posteriorly. Color above pale purplish, with much darker granules, which gives it a beautifully reticulated appearance; beneath paler than above; disk of the foot light purplish-grey. (*Pse.*).

Sandwich Is.

Pleurobranchus reticulatus PSE., P. Z. S., 1860, p. 25 (not of Rang.).—*P. violaceus* PSE., P. Z. S., 1863, p. 510.

O. GRANDIS Pease. Pl. 45, fig. 1.

Shell none. Animal oblong-oval, subpellucid, flaccid, depressly convex, covered with a network of impressed lines, the interspaces finely tuberculated. Mantle covering the head, deeply notched in front. Head small and narrow; oral veil moderately developed, subtriangular, sides biplicate. Tentacles smooth, stout, truncate, involute. Eyes very minute, scarcely visible without the aid of a lens, deeply immersed at the base of the tentacles. Foot large, thin, elongate oblong, convexly truncate and duplicate in front, rounded behind, when creeping projects far behind the mantle, generally much exposed from above, as well as the gill. Gill very large, the two rows of plumules folded against each other, each one consisting of twenty-six tripinnate plumules, disposed alternately, and tuber-

culated at their bases. The gill is attached two-thirds of its length by a lax thin membrane. Anal duct at the posterior end of the membrane, it is cylindrical, truncate and deeply crenulate at the tip. Generative organs very large, immediately anterior to the gill, connected by a prominent grooved ridge. Whole upper surface of the mantle covered with a reticulation of pale bluish ash lines, interspaces fawn color, becoming obsolete toward the margin and more or less dotted with whitish. Also ornamented with a large oblong dorsal spot of deep purple-brown, and a series of irregular shaped spots surrounding it, of same color, all of which are dotted with pale-blue. Head pale, mottled with purple-brown. Tentacles pale at their tips and lineated transversely with darker. The inner portion of the under side of the mantle and upper side of the foot deep purple-brown. Locomotive disk bluish-ash, tinged anteriorly with cream-yellow, and marked posteriorly with a purple-brown stripe. Veil same color as foot. Gill deep purple-brown, generative organs purple-black. Length six inches. (*Pse.*).

Huahine.

Pleurobranchus grandis Pse., Amer. Journ. Conch., iv, p. 78, pl. 10, f. 2 (1868).

This large and delicate species differs from others of the genus, in the mantle being extended over the head and notched for the accommodation of the tentacles; also in the attachment of the branchial plume to the body and the plumules being tuberculated at their base, for reason probably of the large size of the gill. After close examination of several specimens no shell was found. (*Pse.*).

Closely allied to the next species.

O. blainvillii Lesson. Pl. 49, fig. 42.

Length nearly 3½ inches, alt. 2¼ inches. Dorsal disk thin, flat, fleshy and oval, rounded behind, having a sinus in front; of the bluish-white color of porcelain, with white striæ and some purplish rays in the middle; ochrey red toward the anterior border; buccal tentacles and generative organs purple-black. Gill an elegant, bipinnate plume of purplish color. Violet rose tints the body and is grooved by ramifying bluish striæ. The foot is flat, smooth, bluish-white, thicker and colored with carmine at the edge; it is rounded in front and terminates in an obtuse point posteriorly.

Point Venus, Bay of Matavai, Tahiti (Lesson).

Pleurobranchus blainvillii Less., Centurie Zoologique, p. 143, pl. 51, f. 1 (1830); Voy autour du Monde, etc., La Coquille, Zool., ii, pt. 1, p. 291.

O. MAMILLATUS Quoy & Gaimard. Pl. 46, figs. 10, 14, 15.

Large, sometimes over 5 inches long, very soft, remarkable for the brilliance and pattern of colors, the long tubercles and the want of a shell. Mantle much undulating at the edges, notched in front, with a projection in the middle; surface bearing large conic tubercles, variegated with brown and yellow, the intervals colored with shades of reddish-brown and yellow, with spots of a beautiful brown; and here and there are crescents of crimson lake, shaded with reddish; tentacles and head shield dark reddish-brown, the rest of the animal yellowish. Tentacles slit, united at the bases, where the eyes are situated, these being generally concealed by the front edge of dorsal shield. Below the tentacles is the wide, rounded veil, under which the short, large rostrum lies, at its termination the mouth, surrounded by rounded tubercles, bearing two membranous tessellated plates; a short lingual ribbon in the angle formed by them. Foot wide, rounded, with a marginal groove in front, extending beyond the mantle behind. Gill free at the apex only, formed of alternating, very closely pinnate branches (fig. 14). Penis surrounded by palmate and jagged foliations.

Port Louis, Mauritius.

Pleurobranchus mamillatus Q. & G., Zool. Astrolabe, ii, p. 294, pl. 22, f. 1-6.

O. HILLI Hedley. Pl. 47, figs. 18, 19.

Animal elliptical, thick, subglobose; in life, as well as I can recollect, dark plum color; as contracted in alcohol measuring 140 mill. in length by 120 mill. in width and 50 in height; without a shell. Mantle very large, thick and muscular, overlapping the body so as almost to envelope it; irregularly covered outside by numerous large, warty protuberances; deeply, squarely notched in front, entire throughout the rest of its circumference. Rhinophores appressed to each other, externally split to the base, thick and subcylindrical. Eye not observed. Foot large, somewhat cordate in outline, bearing at the tail, on the sole and in the median line, a gland 30 mill. by 10 mill., distinguished from the rest of the sole by its thick transverse rugosities and black color. Gill-plume tucked in between the mantle and the foot, a third as long as the animal,

bipinnate, folded down the center so as to expose one side only, the stalk without the pinnæ within, attached to the body as far as the 16th filament; pinnæ 24, rapidly increasing in length from the anterior to the 6th, thence gradually decreasing to the posterior end, each filament attached beneath for more than half its length; midrib beaded at the junction of each plumelet. Anus just within the tip of the gill and behind the membrane upon which it is hung. External genitalia located immediately before the branchia, wrapped within two oblong flaps. (*Hedley*).

Off Stokes Point, Broken Bay, N. S. W. (Hill); *a mile south of Sow and Pigs Reef, Port Jackson, N. S. W., Australia*, in 8 fms. (Field Nat. Soc. N. S. W.); *Port Stephens, N. S. W.* (Brazier).

Oscanius hilli HEDLEY, Proc. Linn. Soc. N. S. W., (2), ix, p. 127, pl. 7, f. 1, 2 (April 25, 1894).

The figures are copied from Hedley's, drawn from spirit specimens. Fig. 18, ventral view, the free edge of foot bent over to expose the anus, gill-plume and genitalia; on the sole is seen the tail gland. Fig. 19, dorsal aspect.

Genus KOONSIA Verrill, 1882.

Koonsia VER., Trans. Conn. Acad. Arts and Sciences, v, p. 545. —*Pleurobranchillus* BERGH, Rés. Camp. Sci. Albert I, fasc. iv, 1893, p. 27.

Like *Pleurobranchæa* in characters of the head, tentacles, proboscis, gill, tail-gland and tail-papilla; differing from *Pleurobranchæa* in having the mantle-edge projecting and overhanging both on the sides and behind, with a wide groove between it and the foot posteriorly as well as laterally, but in front the mantle passes directly into the veil. Genital openings as in *Pleurobranchus*. Gill free for the greater part of its length. No shell. Type *K. obesa*.

Dentition like that of *Pleurobranchæa*.

Distribution: temperate Atlantic in deep water.

Koonsia is very closely allied to *Pleurobranchæa*, but it is a less specialized type, in having the mantle edges developed and free, as in the more normal genus *Pleurobranchus*. Bergh's genus *Pleurobranchillus* seems to be absolutely synonymous with the group defined by Verrill ten years earlier.

K. OBESA Verrill. Pl. 74, fig. 94.

Body large, stout, broad, with a large, swollen back, smooth and white in the preserved specimens, and defined by the mantle-edge, which forms a rim along the lateral and posterior borders. Head large and broad, with two short, flat, posteriorly grooved, anterior tentacles, one at each corner; the anterior mantle-border runs between them, and supports a row of small papillæ. Posterior tentacles short, stout, flattened, ear-like, with the outer edges incurved, forming a large groove. Proboscis very large, retractile, purple at the end, showing when extended, the very broad radula covered with very numerous sharp, hooked teeth, in many long curved rows. Foot broad and rounded anteriorly, with small auricles; long tapered, and acute posteriorly, extending some distance beyond the mantle; a conical papilla near the tip above; under side, near the end, with a narrow, elongated, depressed, glandular area, surrounded by a raised border; this is sometimes tinged with bright-red, in alcohol; the rest of the foot is usually tinged with chocolate-brown. Gill large, bipinnate, deep purple. (*Verrill.*).

This species grows to a great size. One from station 939, was over 5 inches (128 mill.) long; 4 inches (102 mill.) wide; and about 2 inches (50 mill.) high, even after preservation in alcohol.

Off Martha's Vineyard, in 216–258 fathoms; *Off Delaware Bay* in 312 fathoms.

Koonsia obesa VERRILL, Trans. Conn. Acad., v, p. 545, (July, 1882); Rep. Commissioner Fish and Fisheries for 1883, Appendix D, p. 571, pl. 28, f. 107.

The figure represents the dorsal aspect, two-thirds natural size.

K. MOROSA Bergh. Pl. 54, figs. 90, 91, 92, 93, 94.

Described from a single, very flaccid specimen, measuring 15 mill. long, 10 wide, 5·5 high. In form and dimensions it resembles *P. aurantiacus.* Margin of the mantle equal in width to that of the foot, 1 mill.; tail 2 mill. long; gill 4·5 long, free for over half its length, with 15 pinnules. Anus below the posterior extremity of the gill-insertion; renal and genital pores as in *Pleurobranchus;* at the end of the tail is an elongated gland. Color of the animal preserved in alcohol is grayish, with a quantity of violaceous dots, scattered principally toward the edges of mantle and on the rhachidian part of the gill.

Jaws tessellated as usual, the component plates short, with about 7 subequal denticles (figs. 93, 94). Radula with 37 rows of teeth, 68 to 70 lateral teeth in each half row; teeth long and slightly curved, with a shorter cusp accessory to the main one (figs. 90, 91, 92). This accessory cusp is lacking on the outermost teeth.

No shell.

Western Atlantic (Hirondelle).

Pleurobranchillus morosus Bergh, in Résultats des Campagnes Sci. Albert I, fasc. iv, p. 28, pl. 4, f. 80–93.

K. brockii Bergh. *Amboyna.*

This species of *Pleurobranchillus* is mentioned but not described in Bergh's paper cited above, p. 28.

Genus PLEUROBRANCHÆA Leue, 1813.

Pleurobranchæa Leue, de Pleurobranchæa novo Molluscorum Genere, Diss. Inaug., etc., Halle, 1813, title-page, and pp. 1–13, plate. (*Conf.*, p. 11 "cum animal nostrum * * * *Pleurobranchææ* vel *Pleurobranchidii* nomine insigniendum videtur.").—*Pleurobranchæa* or *Pleurobranchidium* of Blainville and subsequent authors.—*Cyanogaster* Rudolphi (where?), see Blainville, Man. de Malac., p. 471.—*Pleurobranchæna* Meckel, Swainson, Malacol., p. 361.

Body oblong, the united mantle and veil smaller than the foot. Serrate in front and produced at the lateral angles, its edge slightly overhanging on the right side, but not on the left, posteriorly, or in front. Rhinophores inserted far apart, apparently on the mantle. Genital apertures as in *Pleurobranchus*. Mouth proboscidiform. Foot with a gland (more or less visible) on posterior part of sole, and a spur or horn on the tail. Shell wanting.

Radula without rachidian teeth, the laterals slender, with a single long accessory denticle on the main cusp (pl. 53, fig. 84, *P. meckelii* Blv.).

The union of mantle and veil, widely separated rhinophores, enormous size of the proboscis in dead specimens, and the lack of overhanging eaves to the mantle except on the right side, render this group very distinct from other *Pleurobranchidæ* in appearance. There is a posterior siphon, like that of *Aplysiidæ* formed by folding of the mantle over the rear end of the gill.

The species are few and widely scattered.

P. MECKELII Blainville. Pl. 53, figs. 81, 82, 83, 84, 85.

Body oblong, very convex, pale brownish-gray with numerous spots or marbling of blackish-brown over the whole upper surface, the sole almost black, the posterior pedal gland whitish gray. In alcohol the color fades to a very pale gray, dark spots indistinct, sole vermiculate with blackish. Mantle covering only the median part of body, not projecting or sharply defined on the left side and behind, narrowly overhanging on right side; in front produced forward in a crescentic head-piece with laterally projecting processes, fore margin serrate; folded into a permanent excurrent siphon on the right side behind. Rhinophores situated on mantle, wide apart, truncate, slit and rolled; gill small, inserted behind middle of mantle, mainly adnate, bipinnate. Female genital pore on a papilla at anterior insertion of gill; male orifice or penis in front of it. Rostrum, in alcoholic specimens, extremely large and protruding far in front. Foot oblong, subtruncate in front, tapering and rounded behind, having a gland on the sole behind, which excretes through a duct opening on a horn-like papilla on the upper surface of the tail. Shell none, but a large shell-cavity present.

Length of alcoholic specimen with protruded rostrum 55, breadth 21 mill.

Palermo, Sicily (Phil.); *Naples* (Phil., Cantraine); *Gulf of Marseilles* (Vayssière).

Pleurobranchæa LEUE, De Pleurobranchæa novo Molluscorum Genere, 1813, pp. 1–12, plate.

? *Pleur. balearicus* Laroche, CUVIER, Regne Anim., ii, (1817), p. 396, footnote (nude name, the identity of which with *P. meckelii* is surmised by de Blainville).

Pleurobranchidium meckelii Meckel, BLAINVILLE, Dict. Sci. Nat., xxxxi, p. 376 (1826); Man. de Malac., p. 471, pl. 43, f. 3 (false reference to Meckel's Beyträge vergleich. Anat.).

Pleurobranchidium meckelii DELLE CHIAJE Memorie, iii, p. 159, pl. 40, f. 11–17 (1828).

Pleurobranchæa meckelii Lewe, PHILIPPI, Enum. Moll. Sicil., ii, p. 88.

Pleurobranchæa meckelii Leue, DESHAYES, in Cuvier's Regne, Anim., Moll., p. 89, pl. 32, f. 2, 2*a*.—BERGH, Rés. Camp. Sci. Albert I, fasc. iv, pl. 4, f. 96–99.

Pleurobranchidium meckelii Blainv., DESH., Trait. Elém. de Conchyl., pl. 91, f. 1, 2.

? *Aplysia minor* LANKASTER, Philos. Trans., 1875, p. 13 (embryology).

Pleurobranchæa meckelii Leve, CANTRAINE, Malac. Méd. et Litt., p. 87, pl. 3, f. 3.—VAYSSIERE, Rech. Moll. Opistobr., Tectibranches, p. 130, pl. 5, f. 122–125.

Pleurobranchidium delle chiaii VERANY, Catal. Anim. Invert. Mar. del Golfo di Genova e Nizza, pp. 16, 19 (1846).

The mouth parts are always protruded in dead specimens. The species is very distinct from other *Pleurobranchidæ* of the Mediterranean.

In establishing the genus *Pleurobranchæa*, Leue gave no name to the species; a fact which has been overlooked, probably on account of the rarity of the original paper. De Blainville was the first to use to use the specific name *meckelii*, which he ascribes to Meckel. It was never published by that author, however, Blainville's reference in Man. de Malac. being a false one; and while it is possible that Meckel transmitted the specimens to Blainville under that name, no proof thereof is forthcoming, and propriety forbids the citation of Meckel as authority.

Lankaster, with the embryologist's disdain for exactness in small matters of species and genera, calls it *Aplysia minor!*

P. TARDA Verrill. Pl. 53, fig. 86.

Body subovate, stout, thick, often nearly half as broad as long usually less, tapering backward and blunt posteriorly; front broad, convex or subtruncate; back more or less convex or swollen in the middle, with the surface wrinkled or irregularly reticulated, with the sunken lines brown, the reticulations smaller posteriorly. Dorsal tentacles short, stout, wide apart, ear-like, subtubular, having a slit on the outer side, with the edges often rolled in. Gill rather large, well exposed in a dorsal view, situated on the right side, behind the middle, and equal in length to nearly one-fourth the body, plumose bipinnate, with 15 or 16 pinnæ on the upper side. Foot broad, often nearly as wide as the mantle, subtruncate or rounded in front, narrowed and obtuse posteriorly, ordinarily not extending beyond the mantle. The mantle edge is but little prominent, except along the right side. Proboscis protruded in most of the specimens, large, thick, obtusely tapered close to the end, which is emarginate, showing the large odontophore in a broad vertical notch. Reproductive organs large and prominent; the two orifices are situated on a large tubercle in front of the gill. The male organ, in extension, is long,

slender, usually curled, truncate, about equal in length to half the breadth of the body; it is a tubular organ, with a slit along the lower side, formed by the rolling up of a long, thin, membranous process. At the posterior edge of the tubercle there is a shorter, flat pointed process, connected with the female organs. Color of dorsal surface yellowish-brown, lighter or darker and reticulated with dark brown, often specked with flake-white; gill and proboscis dark purplish-brown; the proboscis with a darker dorsal patch; tentacles sometimes crossed by dark brown bands. Foot salmon-color. Odontophore very large and broad, with 150 to 170 rows of teeth; no median teeth; all the teeth are similar in structure, and show only a gradual change in form and size from the inner to the outer ones. The inner ones are elongated, slightly curved, narrow-lanceolate, with a very acute point and with a smaller, narrow, sharp denticle on the inner edge, parallel to but shorter than the main point; the outer teeth gradually become shorter, blunter, with a smaller denticle, which finally nearly disappears. Length, usually 30 to 40; breadth, 10 to 14 mill. (*V.*).

In the best preserved specimens the reproductive organs are often protruded, the forms of the different organs varying with the state of extension. The verge or most anterior organ, when fully extended, is long, cylindrical or a little clavate, with rows of minute recurved hooks near the end, and terminated by a slender curved spicule. The most posterior opening (urinal) is just at the anterior base of the gill, in the form of a small papilla, with a central opening. Between these there are two organs, on a more or less swollen common base; the more anterior is a large opening with raised margin; a little behind and below this is a long, exsert, flat, usually tapered and acute, copulatory organ, varying much in size and form according to the state of extension. All these organs can be so retracted as not to be noticeable, but this seldom happens in alcoholic specimens, most of which show the organs more or less extended. The anal orifice is behind the base of the gill. (*Verrill.*).

20 miles south of Block Island, in 38 fathoms; *about 70 to 100 miles south and southwest from Martha's Vineyard*, in 28 to 310 fathoms, both on bottoms of mud and of fine, compact sand, very abundant; *Off Chesapeake Bay*, in 31 to 300 fathoms; *Off Delaware Bay*, in 130 and 156 fathoms.

With this species, and probably belonging to it, we often took gelatinous, but rather firm, cylindrical egg-clusters, about 20 mill.

long and 4 in diameter, with the eggs in several rows. The species is not common below 200 fathoms. (*Verrill*).

Closely resembles *Pleurobranchæa Novæ Zealandiæ* in form and color. The latter is a littoral species.

Pleurobranchæa tarda V., Amer. Journ. Sci., (3), xx, p. 398, 392 (Nov., 1880); Proc. U. S. Nat. Mus., iii, p. 384 (Dec. 21, 1880); Trans. Conn. Acad., v, p. 546, pl. 58, f. 26; U. S. Commission of Fish and Fisheries, pt. xi, Rep. of Commissioner for 1883, appendix D, p. 571 [69], pl. 28, f. 105.

The figure represents the dorsal aspect, two-thirds natural size, genitalia protruding.

P. MACULATA Quoy & Gaimard. Pl. 53, figs. 88, 89.

Body thick, a little swollen above, covered with low wrinkles. Color dirty white, with light brown spots; sole yellowish; foot wide, rounded at the two ends, and projecting beyond the mantle behind. Veil continuous with mantle, wide, arcuate, crenulated and terminating in two points; surmounted behind by the two short, auriform tentacles. Gill fusiform, free at the end, formed of parallel and oblique foliations, generally uncovered. Penis almost always projecting, large and 4 or 5 lines long. Anus opens above and past the middle of the gill. Mouth at the end of a small rostrum.

Port Western, Jervis Bay, and all this southern part of Australia, in 9–10 fms.

Pleurobranchidium maculatum Q. & G., Zool. Astrolabe, ii, p. 301, pl. 22, f. 11–14.

P. NOVÆZEALANDIÆ Cheeseman. Pl. 53, fig. 87.

Body oval, convex, thick and fleshy, smooth and lubricous to the touch, but the whole surface nevertheless covered with minute puckers and folds. Color light-grey, copiously streaked with irregular anastomosing lines of dark greyish-brown, and sprinkled with numerous minute and almost microscopic white dots. Mantle smooth, not nearly so long as the foot, and not concealing the branchiæ, rather broader on the right side; oral veil broad, extending over and concealing the mouth, in front semicircular, and with a delicate fringed margin; but at each side produced into a short tentacle-like lobe; mouth large, round, in a state of rest concealed in the sulcus between the oral veil and the foot, but capable of being greatly protruded in a proboscidiform manner; buccal plates two, large, finely and regularly reticulated or faceted; odontophore broad, with numerous rows of similar unciform teeth; tentacles dorsal, wide

apart, short and stout, projecting outwards, folded down the outer side, tips obliquely truncate; eyes minute, black, placed within the integument at the inner bases of the tentacles, quite internal, and not to be seen without dissection; foot long, extremely flexible, sole pale ashy-grey; branchial plume often over an inch in length, and free for half that distance; pectinations about 17, finely ciliated; shell none; length 2·5 to 3·25 inches. (*Cheesem.*).

New Zealand: Auckland Harbor, in sandy or muddy localities (Cheesem.); *Port Nicholson* (Hutton).

Pleurobranchæa novæ-zealandiæ Cheesem., P. Z. S., 1878, p. 276, pl. 15, f. 3; Trans. N. Z. Inst., xi, 1879, p. 378, pl. 16, f. 3 (reprinted from P. Z. S.).—Hutton, Man. N. Z. Moll., p. 124.

Subgenus Euselenops Pilsbry, 1896.

Neda H. & A. Adams, Gen. Rec. Moll., ii, p. 40, type *Pleurobranchus luniceps* Cuv. (October, 1854). Not *Neda* Mulsant, Spec. Col. Trim. Sécur., p. 274 (1851), a genus of Coleoptera.

Animal short, depressed, with very broad sole, slender rostrum, and large, crescentic head-shield with produced angles; other known characters as in *Pleurobranchæa*.

P. luniceps Cuvier. Pl. 54, figs. 95, 96, 97.

Body very short, broad and much depressed, the foot extending broadly beyond the mantle on sides and behind. Upper surface pale fleshy purple, sparcely spotted with purple-black angular blotches; lower surface of head-shield densely mottled with purple, the sole deep purple, lighter forward and toward the median line.

Tentacles short, truncate, inserted on mantle as in *P. meckelii*. Veil very broad, crescentic, produced in long processes at the sides Rostrum slender, capable of great extension. Mantle folded into a permanent excurrent siphon behind, as in *P. meckelii*. Foot broad, emarginate or broadly rounded in front and behind, the sole with a median impressed line. Genitalia unknown.

Habitat unknown.

Pleurobranchus luniceps Cuvier, Regne Animal, ii, p. 396, footnote (name only); iv, pl. 11, fig. 2 (1817).—Blainville, Dict. Sci. Nat. xxxxi, p. 371 (1826).—Adams & Reeve, Zool. Samarang, Moll., p. 66, pl. 18, f. 6*a*, *b*.—*Neda luniceps* Cuv., H. & A. Ad., Gen. Rec. Moll., ii, p. 40, pl. 61, f. 1, 1*a* (copied from Voy. Samarang).

Cuvier's figure was evidently reversed in engraving, as de Blainville has remarked, bringing the gill on the left side. The above description is based on the published figures.

SUPPLEMENT TO MONOGRAPHS OF TECTIBRANCHIATA CEPHALASPIDEA.

Family *ACTÆONIDÆ* (Vol. XV, p. 135).

Genus ACTÆON (p. 147).

A. EXILIS Jeffreys (Vol. xv, p. 156) has also been dredged off Ireland to the southeast of Rockall, in 1215 fms. (Norman, Ann. Mag. N. H. [6], vi, 1890, p. 63). Another figure is given in Proc. Mal. Soc. i, pl. 16, f. 8.

Cossmann refers this species to *Crenilabium*, a subgenus of *Actæonidea*. The latter group is in reality a synonym of *Rictaxis* Dall, 1871 (not 1891 as Cossmann states). The references to *Crenilabium* are as follows:

Crenilabium COSSM., Catal. Illustr. des Coq. Foss. de l'èocene des Environs de Paris, in Annales de la Soc. Roy. Malac. de Belgique, xxiv, 1889, p. 302 (type *A. acicalatus* Cossm.); Ess. Pal. Comp., i, p. 53.—*Lissactæon* MONTEROSATO, Il Naturalista Siciliano, p. 188, 1890 (type *A. exilis* Jeffr.).

A. BROWNI Jordan. Pl. 61, fig. 60.

Shell spindle-shaped, opaque and somewhat glossy. Sculpture numerous spiral incised lines, those on the base being much stronger and visible to a sharp eye without the aid of a lens; the spaces between these lines vary in width. Color ivory white; spire moderately elongated and gradually tapering to the apex. Whorls 5, but possibly 6, the apex being broken off, moderately rounded, the last forming about two-thirds of the shell. Suture slightly chanelled when examined by looking down the spire; mouth about two-thirds of the length of the shell, acute angled above. Outer lip thin and unfortunately broken. Inner lip inconspicuous; pillar short and flexuous. Fold or plait winding obliquely down the pillar, and not tooth-like as in *A. tornatilis*. Operculum ear-shaped and marked with transverse lines of growth. Long. 8·12, diam. 3·15 mill. (*Jordan*).

"*Warm area, Faroe Channel*," *about 80–90 miles N. of the Butt of Lewis*, 570 fms.

Actæon browni JORDAN, Proc. Malac. Soc. i, p. 267, pl. 16, f. 7.

One specimen collected.

ADELACTÆON Cossmann, 1895.

Ess. Pal. Comp., p. 54, type *A. papyraceus* Bast., Miocene.

Proposed as a substitute for *Myonia* A. Ad. *non* Dana, see Vol. xv, p. 167. Includes several Miocene species, the recent *A. concinna* Ad. (Vol. xv, p. 172) of Australia, and several Japanese forms (see Vol. xv, p. 169, 170).

Genus KLEINELLA A. Adams (Vol. xv, p. 179).

Cossmann, in his excellent Essais de Paléoconchologie Comparée, pt. 1, p. 44 (1895), has been able, by the assistance of Messrs. R. B. Newton and E. A. Smith, to figure the type of this genus, *K. cancellaris* Ad., and to determine the fact that it does not belong to the *Actæonidæ*, but is allied to *Menestho*. His figure of *K. cancellaris* is reproduced in figure 6 of Frontispiece. For description see Vol. xv, p. 180.

Actæon aplisiformis Fér., Tab. Syst., p. xxx=*Elysia viridis* Bosc.

Actæon viridis Fér. *l. c.* (*Laplysia viridis* Mont.)=*Elysia*, a nudibranch.

Family *AKERATIDÆ* Pilsbry, (Vol. xv, p. 350).

Genus AKERA (Vol. xv, p. 376).

A. BULLATA Müller (Vol. xv, p. 377).

Var. *nana* Jeffreys. Length $\frac{3}{20}$ inch.

Var. *farrani* Norman. Length $1\frac{3}{4}$ inch. (=*A. bullata* var. *gigantea* Norman, Mus. Normanianum, iv, Moll. 1888, No. 101).

The variation in size in this species is most extraordinary, and perhaps the forms here treated as varieties should rather be regarded as entitled to rank as species. The full size of ordinary specimens may be taken as an inch; but no specimens of var. *nana* which were dredged by Jeffreys and myself in shallow water at Balta Sound, Shetland, exceed three-twentieths of an inch. On the other hand, Dr. Farran found many years ago (see Nat. Hist. Review, Vol. iv, [1857] p. 74) the gigantic variety which I here name after him. The specimens were dredged near Birterbuy Bay, Ireland; the animal measured 3 inches long and $2\frac{1}{2}$ wide, and weighed $2\frac{1}{2}$ ounces. The shell of one of these giants now in my collection measures $1\frac{3}{4}$ inches long and an inch wide; hundreds of specimens of var. *nana*

might be placed in it as in a box! In 1876 in company with my friend Mr. David Robertson, I dredged diligently the spot carefully described by Farran, but without again meeting with this form; but Mr. A. G. More informed me that the year before that just mentioned he had found a similar sized specimen in a lough near Galway. (*Norman*, Ann. Mag. N. H., 1890).

Genus VOLVATELLA Pse. (Vol. xv, p. 382).

V. LAGUNCULA Sowerby.

Shell ovate-cylindric, membranaceous, involute, abruptly contracted behind, shortly produced, rounded in front. Aperture widely ovate in front, sinuous behind, very narrow, the right lip truncate at both ends, inflexed in the middle, left lip lightly reflexed. Length 6, diam. 3½ mill. (*Sowb.*).

Port Elizabeth, S. Africa.

Volvatella laguncula SOWB., Journ. of Conch., vii, p. 373.

Compared with *V. cumingi* it is much smaller, less abruptly truncated and produced posteriorly, and proportionately wider anteriorly; it is also less cylindrical in form than *V. cincta* of Nevill, and shows no sign of the transverse bands characteristic of that species. (*Sowb.*).

CYLINDROBULLA SCULPTA Nevill (Vol. xv, p. 381) is reported from South Africa by Sowerby, *l. c.*

Genus HAMINEA Leach, (Vol. xv, p. 352).

H. BINOTATA Pilsbry.

Shell cylindric-oval, hardly wider below, truncated above, rounded beneath, thin, but rather solid, ruddy-corneous, with a small opaque-white spot at each end, that at apex bounded below, that at columella, above, by an opaque orange or reddish tract, appearing only on the latter part of the whorl. Surface polished, with excessively fine and close spiral striæ, and rather coarse growth wrinkles. Aperture rather narrow, moderately enlarged below. Outer lip rising slightly above the vertex, but by no means high-arched. Columella concave, short, with a lunate, reflexed, but free, not adherent, flange, but no fold. Apex closed or subperforate. Alt. 11, diam. 7 mill.

Yaeyama (Okinawa), Loo Choo Is. (Stearns).

H. binotata Pils., Catal. Mar. Moll. Jap., p. 185 (1895).—*H. binotata* var. *japonica* Pils. *l. c.*

Var. *japonica* Pilsbry.

Shell like the above in coloration and sculpture, but smaller, thin and fragile, more swollen, the reflexed columellar callus thinner and adnate to body. Alt. 9, diam. 6·2 mill.

Nemoto, Boshiu, Japan (Stearns).

Family *BULLIDÆ* Pilsbry, (Vol. xv, p. 326).

Bulla semilevis Seguenza (Vol. xv, p. 339).

Canon Norman, in Ann. Mag. Nat. Hist. (6), vi, 1890, p. 67, states that this is the same as the later *Bulla guernei* Dautz. (see Manual xv, p, 336), and further "it is clear also, I think, that *B. eburnea* Dall [Manual xv, p. 339] is the same thing." The localities quoted in Vol. xv for these synonyms, should be added to the range of *B. semilevis*, with the following: *off the south of Ireland*, 1000 fms. ('Flying Fox' 1889, E. A. Smith).

Bulla diaphana Montagu, Test. Brit., p. 225, is said by Jeffreys to be the young of *Cypræa europæa* (Ann. Mag. N. H. [4], vii, p. 245, 1871).

Bulla jeverensis Schroeter, Archiv für Zool. u. Zootomie, iv, p. 16. An undetermined small form, perhaps *Retusa*, from the North Sea.

Family *TORNATINIDÆ* Fischer, (Vol. xv, p. 180).

Tornatina parviplica Dall. Frontispiece, fig. 7.

This species resembles *T. recta* Orb. in a general way, especially when young, and is distinguished from it by its more rounded surface between the sutures of the spire, and by the obsolete plait on the pillar; the adult is a much thinner yet wider shell than *T. recta*, and reaches a length of 6·5 and a width of 3·25 mill., with five whorls, beside the projecting sinistral nucleus. The spire is moderately elevated, the top of the last whorl flattish, but without canaliculation; the surface is faintly marked with lines of growth, not polished and entirely without spiral sculpture. The umbilicus is not perforate, and the plait is formed by the twisting of the thickened pillar, not superimposed upon the pillar. It is only known from the lagoons. (*Dall*).

Watling Island Lagoon, Bahamas.

Tornatina parviplica DALL, Bull. Mus. Comp. Zool., XXV, no. 9, p. 115, fig. 8 (Oct., 1894).

RETUSA [*Coleophysis*] EFFUSA Monts. (Il Naturaliste Siciliano, ix, p. 188, 1890) is an insufficiently described form from Villafranca.

RETUSA OVATA Jeffreys (Vol. xv, p. 232). See Norman, Ann. Mag. N. H. (6), vi, p. 64, for a discussion of the synonymy and range.

BULLA CRETICA Forbes. B. testa globosa, alba, lævigata, spira manifesta, umbilicata, margine rotundata; apertura superne contracta, inferne dilatata; columella perforata. Long ·1 unc. *Crete*, in 119 fms. (Capt. Graves, 1843). (*Forbes*, in Rep. Ægean Invert., Rep. Brit. Asso. Adv. Sci. for 1843, p. 188, 1844.

An unrecognized form, perhaps belonging to *Retusa* or *Cylichna*.

Acrostemma Cossmann, 1895.

Ess. Pal. Comp., p. 101. Type *Bulla coronata* Lam., Eocene.

The recent *B. striatula* Forbes (Vol. xv, p. 212) is placed in this group, which is ranged as a subgenus under *Roxania* by Cossmann.

Family *RINGICULIDÆ*.

Genus RINGICULA (Vol. xv, p. 394).

Cossmann substitutes *Ringiculella* Sacco, 1892, type *R. auriculata* for *Ringiculina* Monts., 1884, but the latter should, I believe, be retained, if the group is worth a name.

Genus PUGNUS Hedley, 1896.

Pugnus HEDLEY, Records of the Australian Museum, ii, no. 7, p. 106.

By its thrice folded columella, anterior canal, thickened outer lip, and sculpture of spiral grooves crossed by transverse striæ, this very distinct genus takes a place in the family Ringiculidæ. From the only other surviving genus, *Ringicula*, *Pugnus* is separated by its involute shell and buried spire. In the shortness of the spire the Cretaceous fossil *Avellana* occupies a position intermediate between these two. Its contour is, however, more globose, and those subordinate groups which agree with *Pugnus* in possessing a smooth lip, appear to differ by having one columella plication only. (*Hedley*).

The form of the lip and plicate columella suggest *Cyprœactœon* White (Contr. Paleont. Brazil, p. 176, in Archivos do Mus. Nac. do Rio de Janeiro, vii), but that Cretaceous fossil is a large form, with inflexed, crenulated outer lip and apical umbilicus. The Brazilian species, being an internal cast, no information is available on the sculpture of the shell. It is doubtful whether *Cyprœactœon* is really a Tectibranch. *Ovulactœon* Dall (Vol. xv, p. 178) has no columellar folds.

P. PARVUS Hedley. Pl. 74, fig. 7.

Shell minute, white, solid, oblong, involute, spire buried, imperforate at either extremity, the posterior of the inner portion of the last whorl obliquely sloped. Sculptured by about thirty spiral grooves, whose interstices are three times their breadth, and are cut by longitudinal striæ into squarish facets. Aperture as long as the shell, vertical, contracted in the middle, expanded anteriorly and posteriorly, inner lip overlaid with callus; outer lip smooth, greatly thickened externally and internally, springing from a false umbilicus in the vertex, arched higher than it, arcuate peripherally, curving below the whorl up to the columella and chanelled at the junction; anteriorly the columella bears a strong entering fold, posterior and parallel to which is a weaker one, and posterior to this again a small deeply-seated third fold is just distinguishable. Length 1½, breadth 1 mill. Animal unknown. (*Hedley*).

Manly, near Sydney, alive, at low tide on rocks, and dead in shell sand from *Middle Harbor, Port Jackson, Australia.* (A. U. Henn).

P. parvus Hedley, *l. c.*, p. 106, pl. 23, f. 1.

Family *SCAPHANDRIDÆ* (Vol. xv, p. 242).

Genus SCAPHANDER (Vol. xv, p. 244).

S. ALATUS Dall. Pl. 74, Fig. 4.

Shell pure white, with a pale straw-colored epidermis, polished, punctate, with a pervious axis; sculpture of faint lines of growth crossed by numerous fine rows of punctures, with wider, pretty regular, interspaces; behind the pillar-lip a few of these rows are so impressed as to form grooves; form of the shell ovate, attenuated in the posterior third; aperture as long as the shell, narrow behind, rounded in front; outer lip sharp, produced behind the immersed spire in an alate manner; body with a thin wash of smooth pure

white callus; pillar lip twisted about a pervious axis, stout, thick, with a narrow groove behind its anterior part, but no umbilical chink. Extreme length of shell 35, maximum diameter 20 mill. (*Dall*).

This species belongs to the section *Bucconia* Dall. It is nearest allied to the type of that section, *S. nobilis* Verrill, from which it may be at once discriminated by its more attenuated posterior third and generally thicker shell and less inflated form, and by its alate outer lip. The gizzard plates are somewhat less distinctly quadrate than in *S. nobilis*. The *Challenger* obtained west of Papua a species of this group, *S. mundus* Watson, which is very like *S. nobilis*, but cannot be confounded with the present species (*Dall*).

Near the Hawaiian Is., in 298 fms. (Albatross).

Scaphander alatus Dall, Proc. U.S. Nat. Mus., xvii, 1894, p. 676, pl. 27, f. 2.

S. andamanicus E. A. Smith. Frontispiece, fig. 18.

Shell ovate, thin, white, here and there ferruginous stained, transversely punctate-striate, above and around the base encircled with few, hardly punctate striæ; spire immersed, concave. Aperture large, wide below, narrow above; lip slightly arcuate, very thin, above white calloused at the thickened insertion; columella strongly arched, convolute, and visible to the apex within, white and thick. Alt. 18, greater diam. 12, lesser 9 mill.; aperture 18 mill. long, 9 wide below (*Smith*).

Andaman Sea, in 250 fms.

S. andamanicus Smith, Ann. Mag. N. H. (6), xiv, p. 167, pl. 4, f. 15 (Sept., 1894).

The punctured grooves, about 40 in number, are not always equidistant, and the punctures are also variable in size (*S.*).

Subgenus Sabatia Bellardi (Vol. xv, p. 255).

S. pustulosa Dall. Pl. 74, fig. 5.

Shell solid, large, subpyriform, with wholly immersed spire and granular callous body lip; surface polished, sculptured by deep, rather wide, channeled grooves; punctate, but with the punctures overlapping one another so that the line presents an annulate aspect. There are a few intercalary, fine impunctate lines also. The form of the shell is rather rounded, smaller posteriorly, with an obscure constriction about the middle of the shell; apex dimpled, but

imperforate; aperture narrow behind, wide and rounded in front outer lip thin, raised above the apex, but hardly alate; inner lip thick, callous, with numerous pustules, the axis barely pervious; pillar thick, pustular, its outer edge high, with a groove behind it, but no umbilical chink. Extreme length of shell 33, maximum diameter 20 mill. (*Dall*).

This species recalls the more inflated *Scaphander niveus* Watson, from near the Philippines, but is readily distinguished by its more attenuated *Bulla*-like form. It may, when older, exhibit a more prominent body callus than is shown by our specimen, the granulation of the pillar being much like that of adolescent specimens of *Sabatia bathymophila* Dall, from the deeper waters of the Antilles. (*Dall*).

Near the Hawaiian Is., in 295 fms. (Albatross).

Sabatia pustulosa DALL, Proc. U. S. Nat. Mus., xvii, 1894, p. 677, pl. 26, f. 10.

Genus ATYS Montfort (Vol. xv, p. 261).

It is evident from the very meager data at hand regarding the soft parts of the species grouped under *Atys*, that at least two or three genera will be formed by its disintegration. The dentition of typical *Atys* and of *Alicula* is still unknown. The dentition and external anatomy of *Roxania* (see Vol. xv, pl. 61, f. 32, and pl. 59, f. 13) and of *Weinkauffia* (this vol. frontispiece, figs. 10, 11, 12) show that these belong to two distinct though allied genera.

Roxania will probably include *Roxaniella* as a subordinate group. Whether *Weinkauffia* is generically distinct from *Atys* or *Dinia* remains to be seen, the latter being still unknown anatomically.

Vayssière has recently (Journ. de Conchyl., 1893, p. 90, pl. 4) examined *Atys* (*Weinkauffia*) *diaphana* Arad. & Mag. Part of his text and figures are given below. The systematic position of *Weinkauffia* which he suggests (between *Bulla* and *Haminea*) seems to me to be wholly untenable.

ATYS DIAPHANA Arad. & Mag. Frontispiece, figs. 8–14.

Animal with numerous spots of a beautiful brown-red color of very diverse forms and irregularly scattered, disposed in three series across the shell through which (by its transparence) they are seen. Head-shield squarish, with two posterior conic processes, the eyes contiguous, near posterior part of head shield; pleuropodial lobes

little developed, anterior, reflexed only over the anterior edges of shell (see fig. 10, dorsal, and fig. 11, external view).

Jaws (fig. 8) composed of little compressed, imbricating pieces. Radula with the formula 3.1.3; rachidian tooth somewhat rudimentary, quadrangular, the cusp small, a little recurved and bilobed. Inner two laterals on each side of about the same form; the curved cusp bearing very fine denticles along the concave side; third lateral on each side subobsolete, without denticles (fig. 12).

The gizzard contains three large, brown-blackish, corneous pieces (figs. 14, 13).

Shell white, rather corneous, very hyaline, of an oval-elongated form; on the back of the shell there are five transverse parallel and slightly oblique striæ in front, and behind there are three similar striæ.

See Vol. xiv, p. 278. The species also inhabits the Gulf of Marseilles, but sparingly. The specific name is preoccupied by Montagu, so one of the later names will be substituted.

Subgenus ALICULASTRUM Pilsbry, 1896.

=*Alicula* EHRENBERG, 1831 (see Vol. xv, pp. 261, 262, 265), not *Alicula* Eichwald, Naturhistorischer Skizze von Lithauen, Volhynien u. Podolien (Vilna, 1830) p. 214, proposed for *A. okenii* (*l. c.* p. 214, footnote), *A. lichtensteinii* and *A. volhynica* (*l. c.* p. 215).

Alicula Eichw. has been given precedence over *Alicula* Ehrenberg by Cossmann, who considers it to indicate the same group. This, however, is an error. Eichwald's *Alicula* has a projecting spire, and is certainly a totally different thing. Eichwald calls it a transition from *Oliva* to *Voluta*. For Ehrenberg's group the new name given above may be used.

CLISTAXIS Cossmann, 1895.

Ess. Pal. Comp., p. 90. New name for *Cryptaxis* Jeffreys *non* Lowe, type *Cylichna parvula* Jeffr. (Vol. xv, p. 293).

While possibly distinct, the shell-characters alone are not sufficient for the generic elevation of this form, which probably belongs to either *Cylichna* or *Retusa*.

Genus DIAPHANA Brown (Vol. xv, p. 280).

D. (?) FRAGILIS Vélain. Vol. xv, pl. 23, fig. 50.

Shell short and subcylindric, truncate at base, thin, translucent and gray; surface ornamented with little longitudinal striæ, very

closely placed. Aperture largely embracing, lengthened, narrow and subangular at base, which is longer than spire, more dilated and rounded above; columella narrow, elevated, a little twisted, the lower columellar margin strongly convex toward its middle; umbilicus small, circular, narrow and profound.

Alt. 2½, diam. 1 mill. (*Vél.*).

Island of St. Paul, inside the crater, under stones at low water.

Bulla fragilis Velain, Comptes Rend., 1876; Archiv. Zool. Expér. et Génér., vi, 1877, p. 128, pl. 4, f. 31.—*B. divæ* Velain, *t. c.*, p. 144.

Looks like a young shell.

Family *PHILINIDÆ* (Vol. xvi, p. 1).

Genus PHILINE Asc. (Vol. xvi, p. 2).

The references to *Colobocephalus* and *Colpodaspis* should be omitted from the generic and specific descriptions and references, as it was deemed best to admit both as genera, pending definite information on those forms. Add the following:

P. tincta Verrill.

Shell broad, oblong, rather large for the genus, widest in the middle, very thin, tinged with smoky brown, not polished and without distinct spiral lines, but with very distinct, fine, close, sinuous, slightly raised, minutely wavy lines of growth. The apex is rounded and shows neither spiral whorls, nor a depression. The outer lip rises slightly above the body-whorl from which it is separated by a broad and deep notch; from the posterior shoulder to the anterior end it is broadly flaring and convex, with a slight-rounded angle about the middle; anteriorly it is a little narrower and evenly rounded; the columella margin is slightly excurved, with a thin edge in front of the middle, and is reflected against the body-whorl, where it joins it leaving a slight groove behind it, and winding into the shell it forms a distinct, raised spiral fold, separated from the more prominent inner surface of the body-whorl by a concave groove.

Length, 10·75; breadth in middle, 8; breadth of aperture, 7 mill. (*Verrill*).

Off Martha's Vineyard, in 65 fms. ("Albatross").

P. tincta V., Tr. Conn. Acad., v, p. 544 (July, 1882).

Family *AGLAJIDÆ.*

Genus AGLAJA Renieri (page 44).

The following forms were overlooked in the preparation of this monograph:

A. ORBIGNYANA Rochebrune. Pl. 54, fig. 3.

Body thick, ovoid; foot short, sub-bipartite below, blackish striated with radiating striæ; posterior lobes visibly elevated, of a black-violet, ornamented longitudinally with irregular interrupted yellowish lines; margins of mantle undulated, quite thick, greenish gray. Length 14, width 11 mill. (*Rochebr.*).

Road of Santiago, Cape Verde Archipelago (*Cessac*).

Posterobranchus orbignyanus ROCHEBR., Bull. Soc. Philomath., 1881, p. 28; Nouv. Arch. du Mus., 1881, p. 265, pl. 18, f. 5.

A. TRICOLORATA Ren. (p. 45).

Add the synonym: *Doridium achates* DESH., Traité Elém. de Conch., Expl. des Planches, p. 58; Atlas de Conchyliologie, pl. 91, f. 3–5.

Family *GASTROPTERIDÆ* (Vol. xvi, p. 39).

GASTROPTERON MECKELII (?) is reported by Dall from east Florida and Guadalupe, in Catal. Mar. Moll. S.-E. U. S., Bull. 37 U. S. Mus., p. 88.

Family *RUNCINIDÆ* (Vol. xvi, p. 171).

PELTA CAPREENSIS Mazzarelli, Atti Acc. Napoli, vi, No. 4, p. 3, from the Gulf of Naples, is a new species of *Runcina*, of which the description is inaccessible to me.

ERRATA.

P. 89. After *T. Robertsi*, read pl. 55, figs. 5, 6.
P. 96. After *T. Tryoniana*, read pl. 57, figs. 24–27.
P. 155. Omit f. 35 from references in fifth line from bottom.

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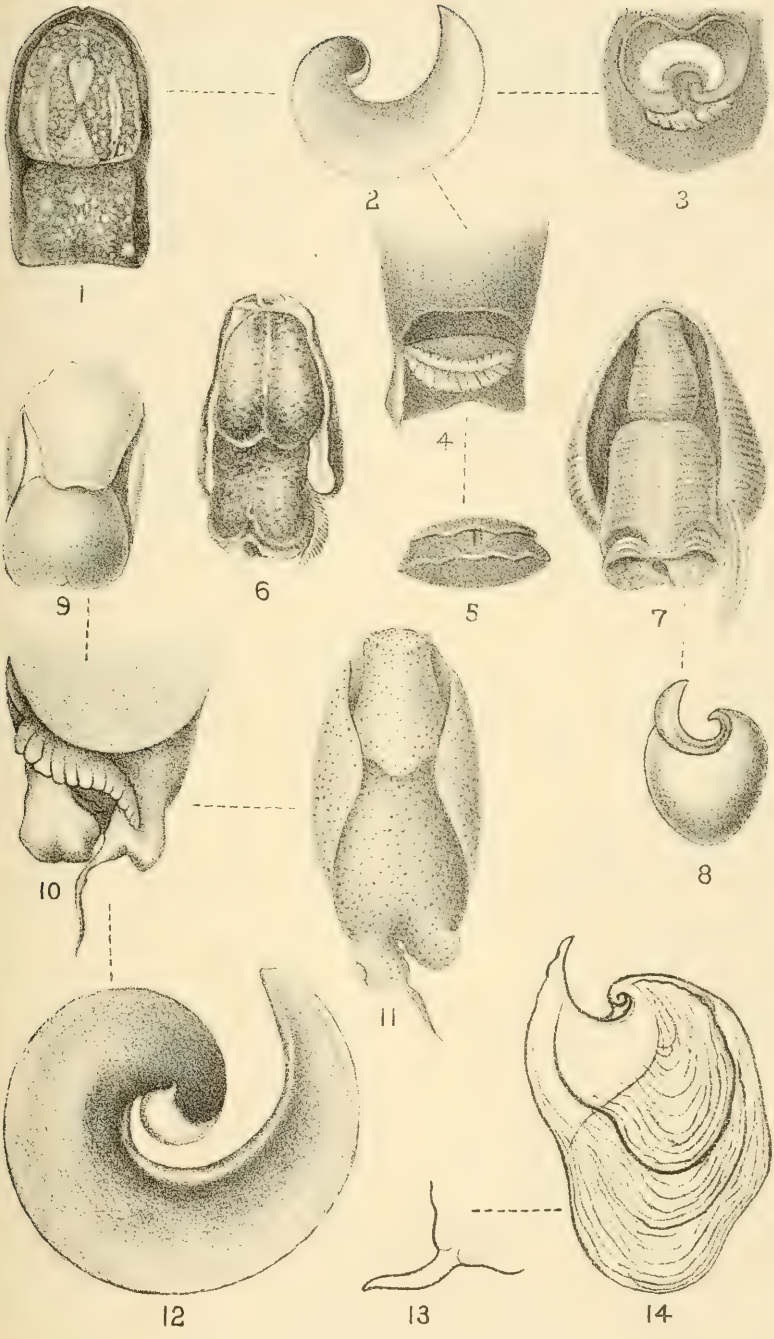
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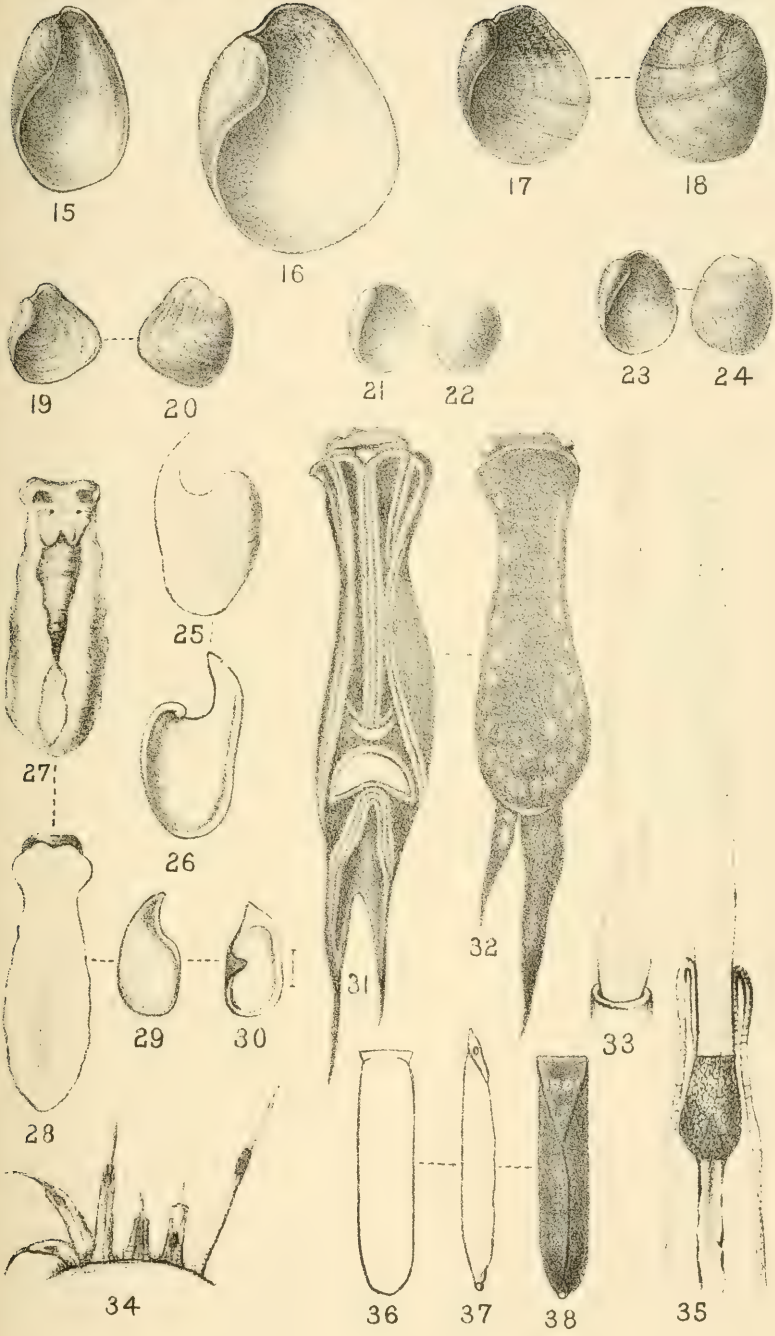
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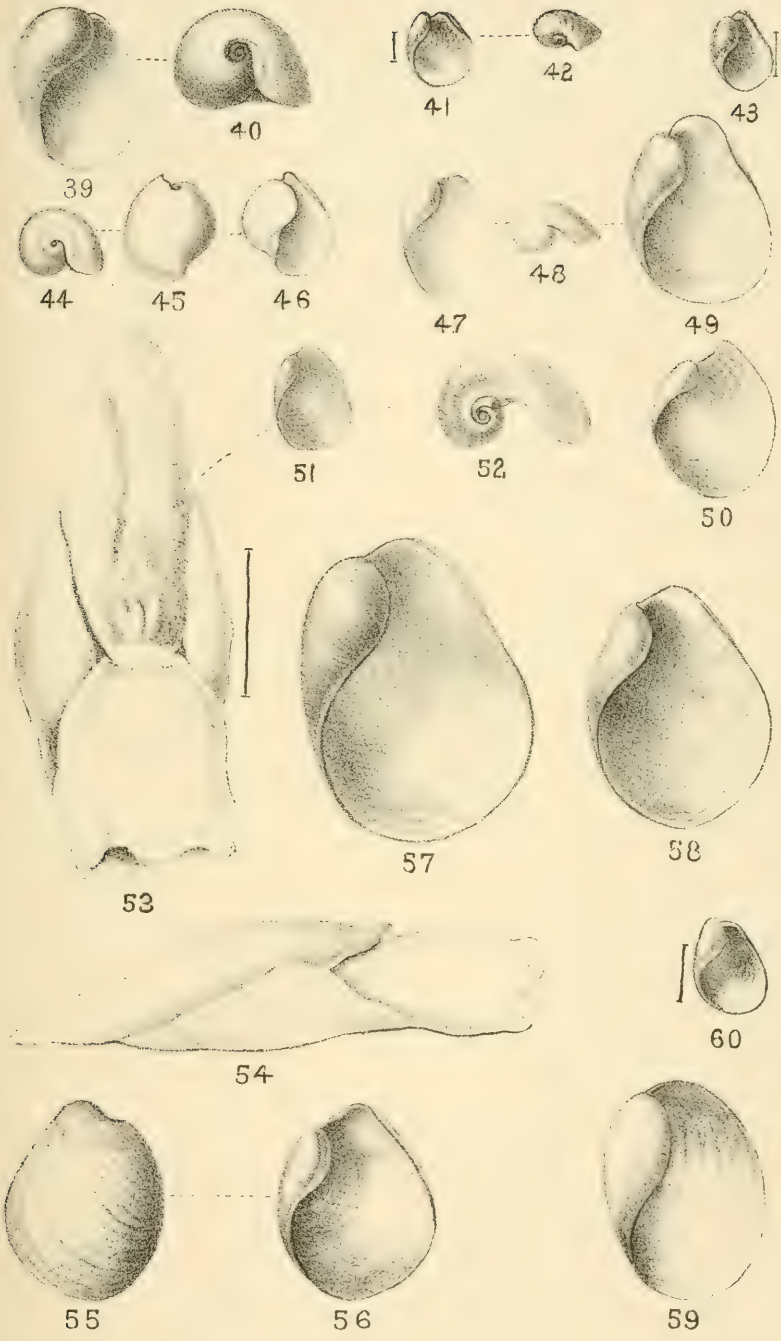
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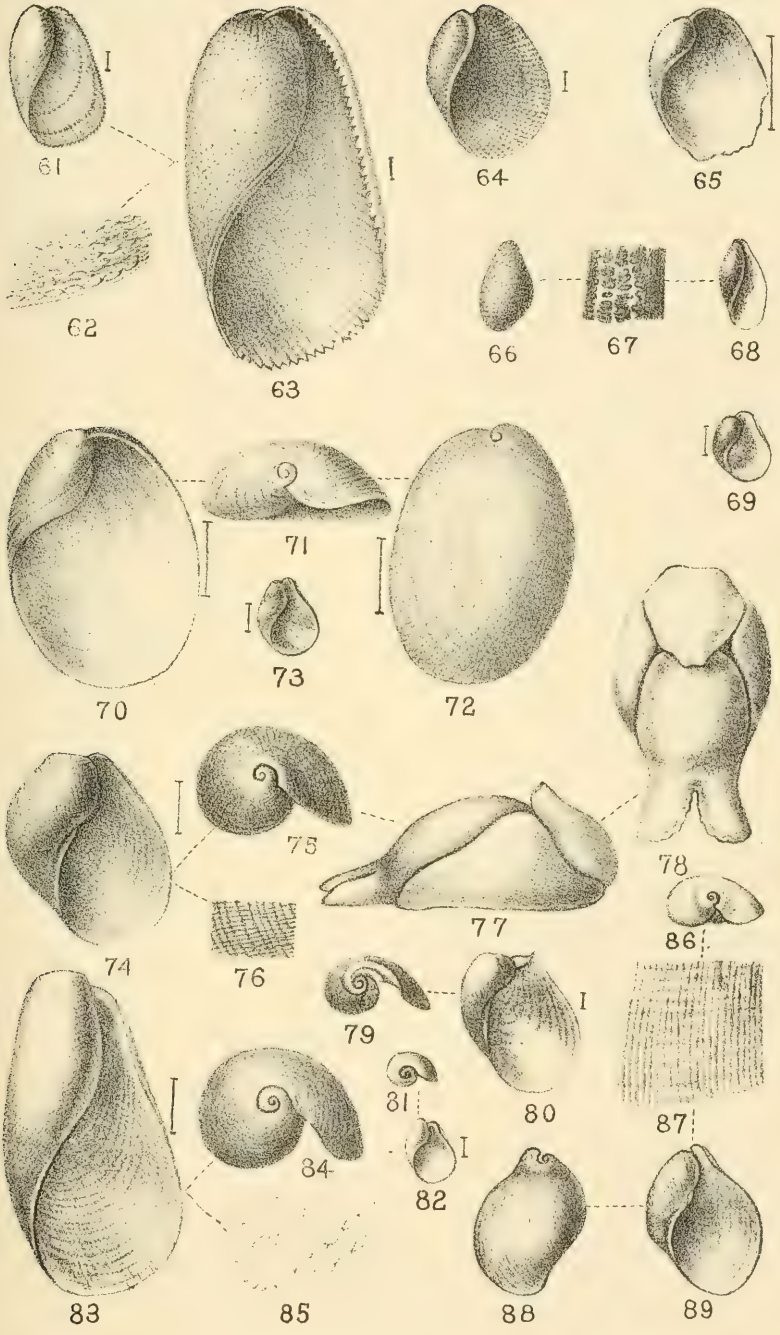
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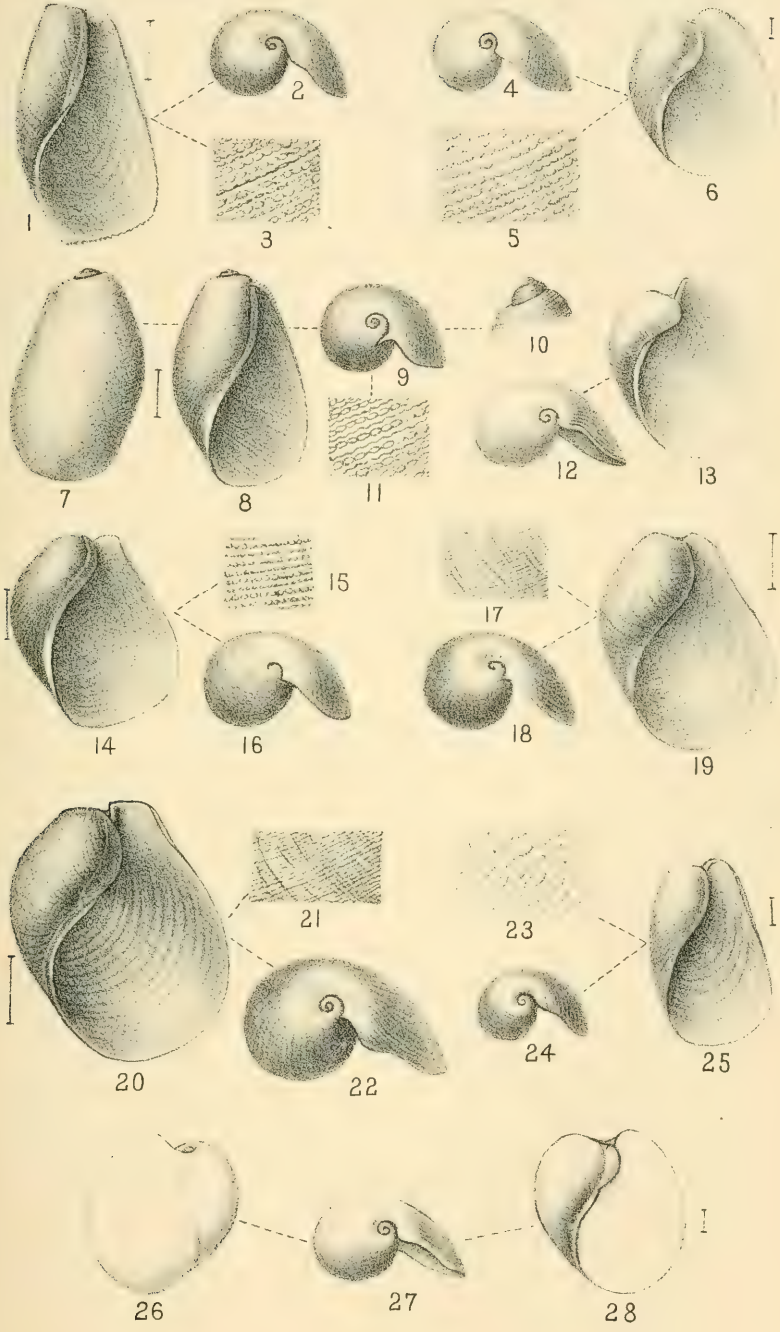
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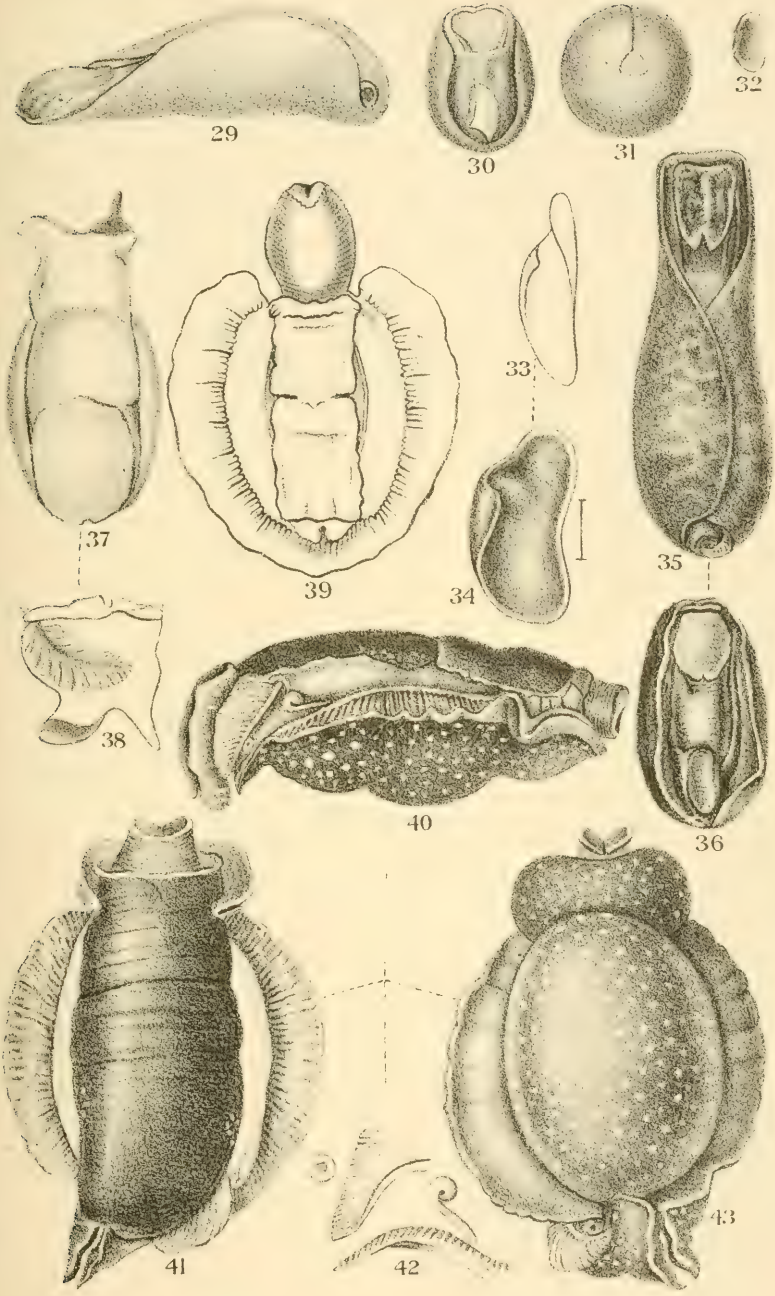
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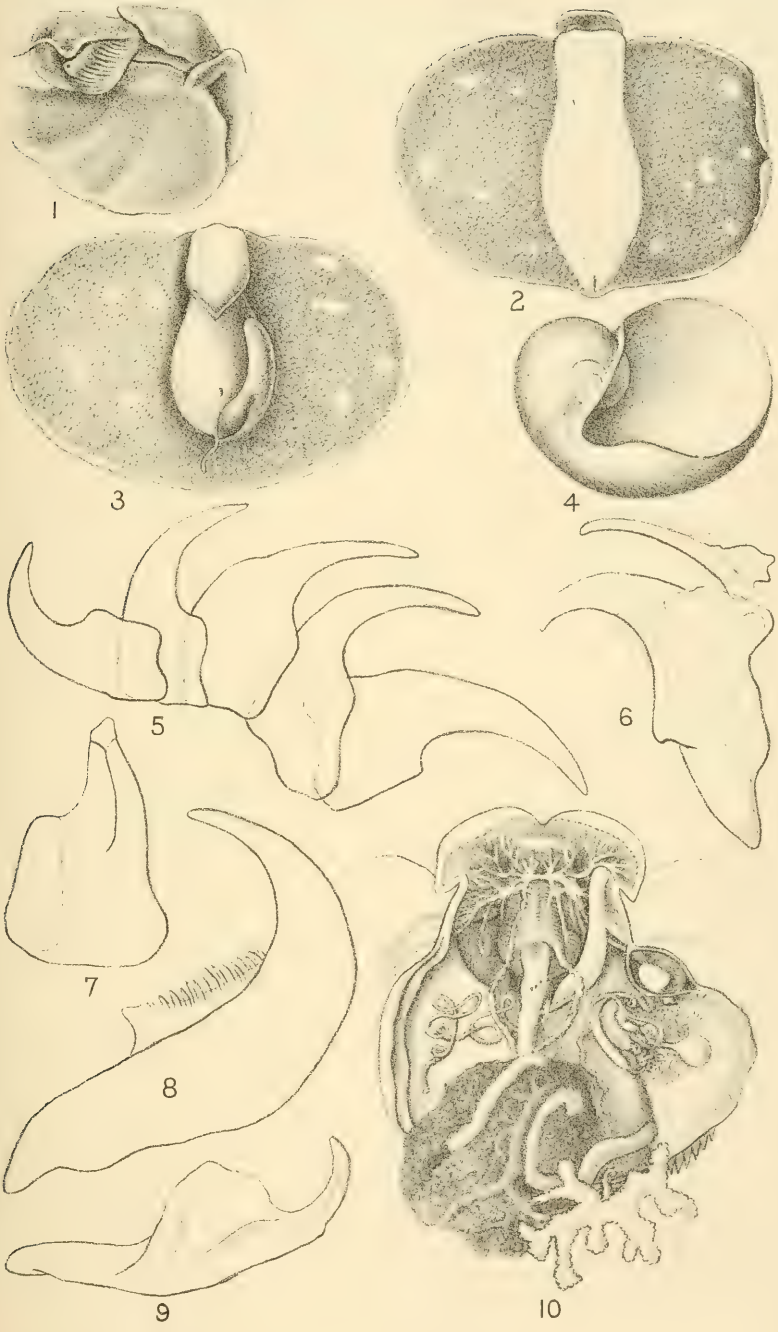
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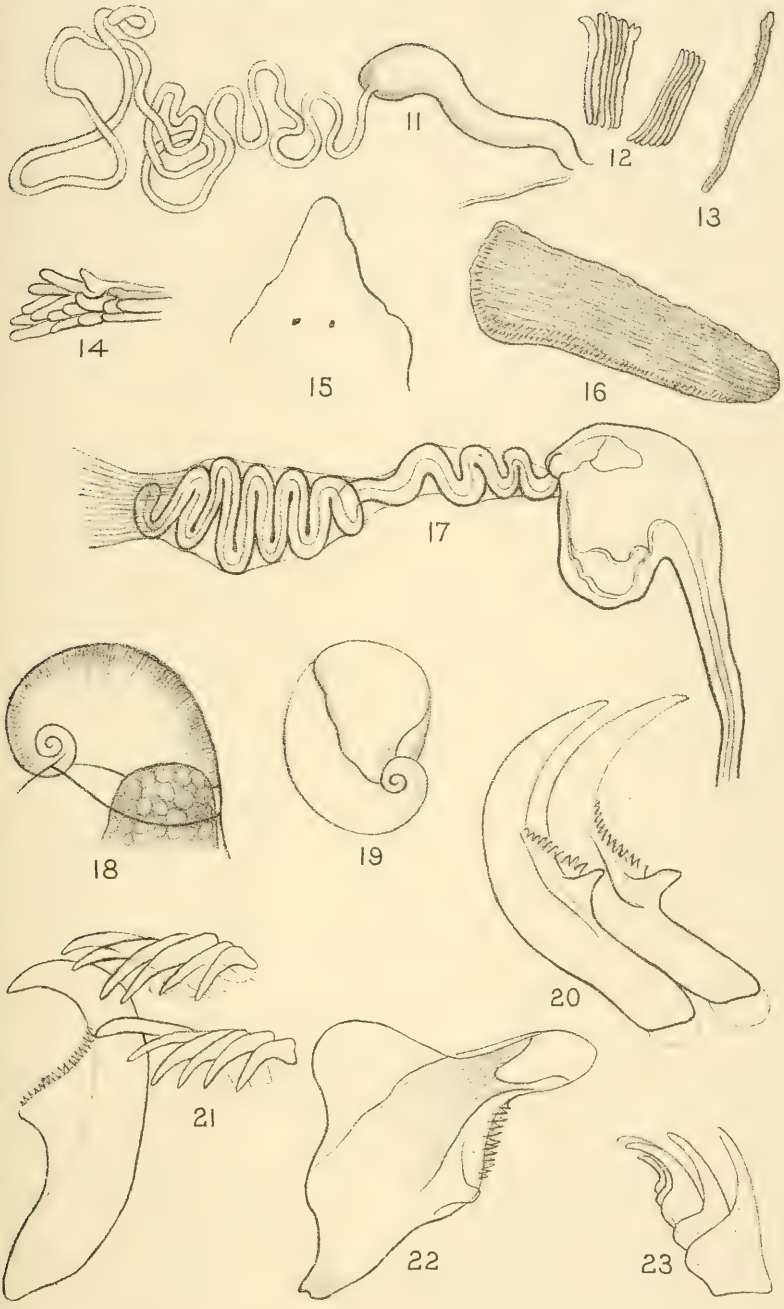
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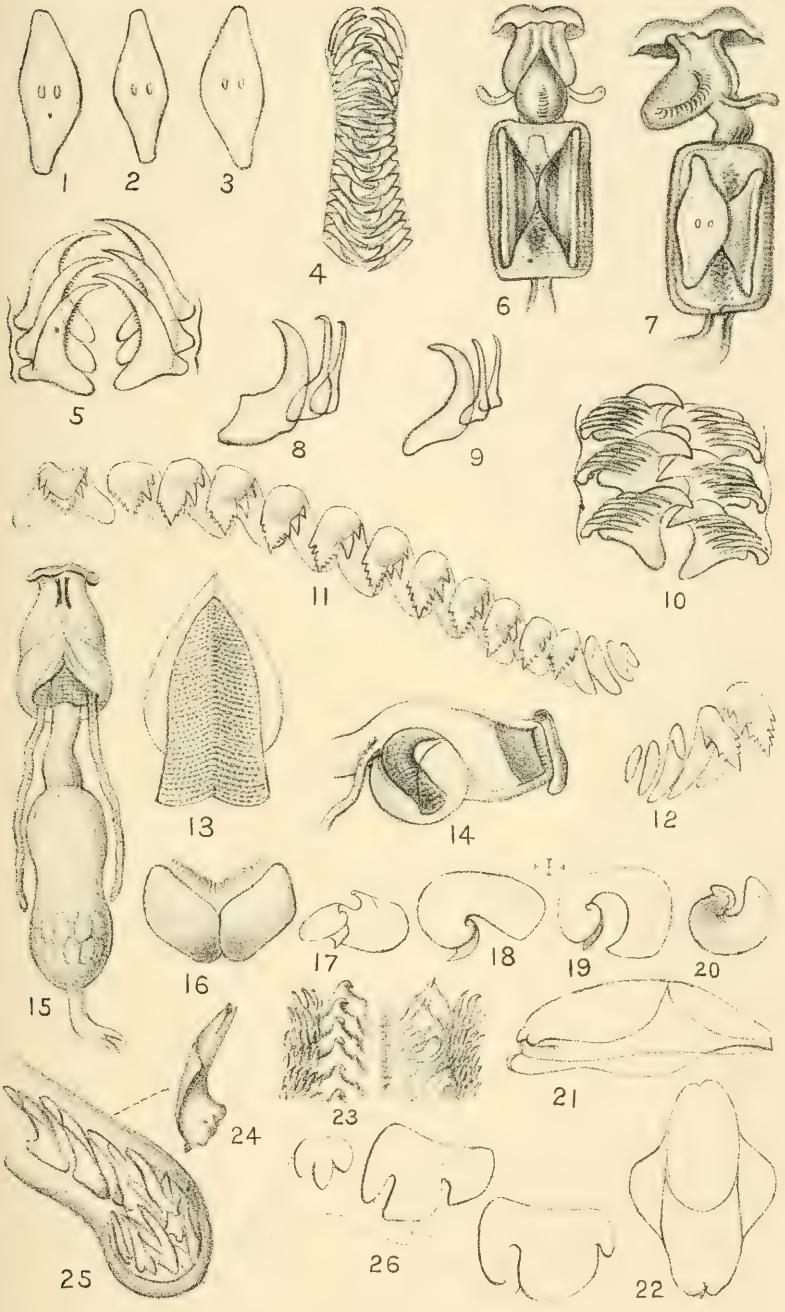
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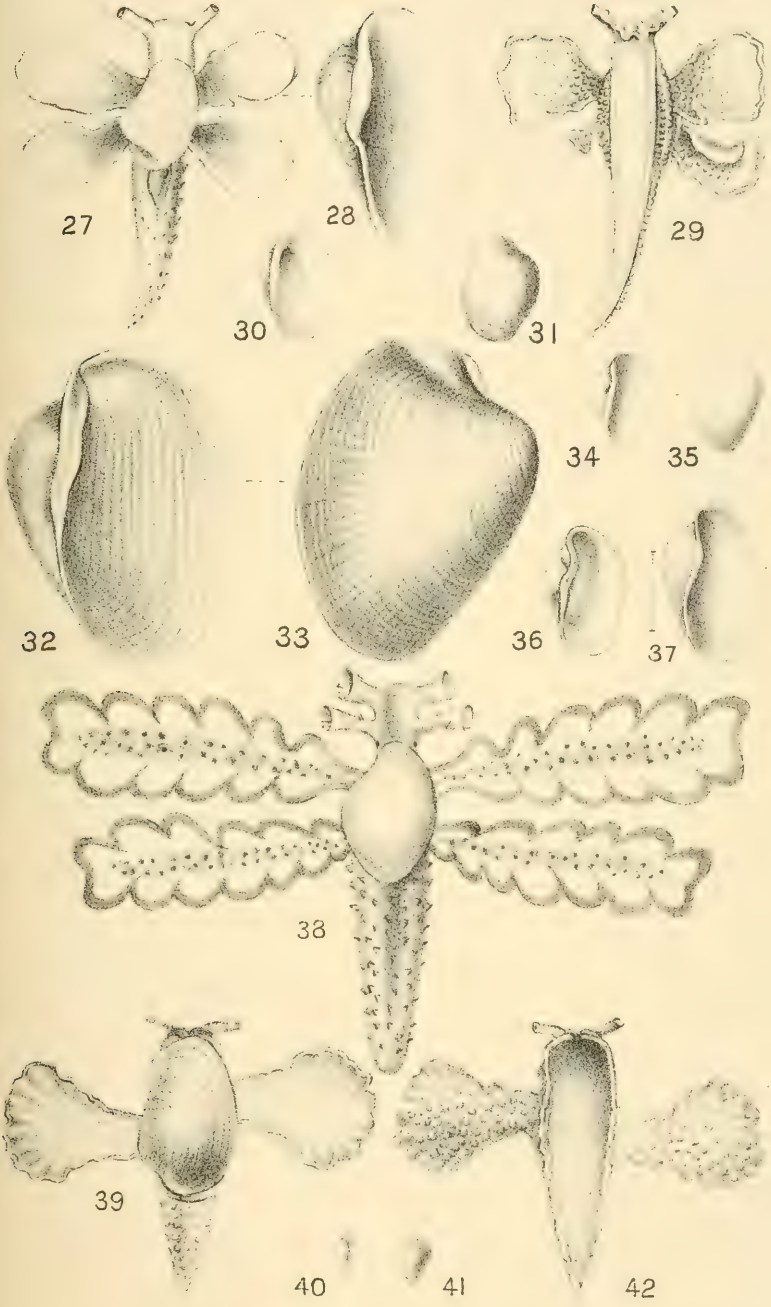
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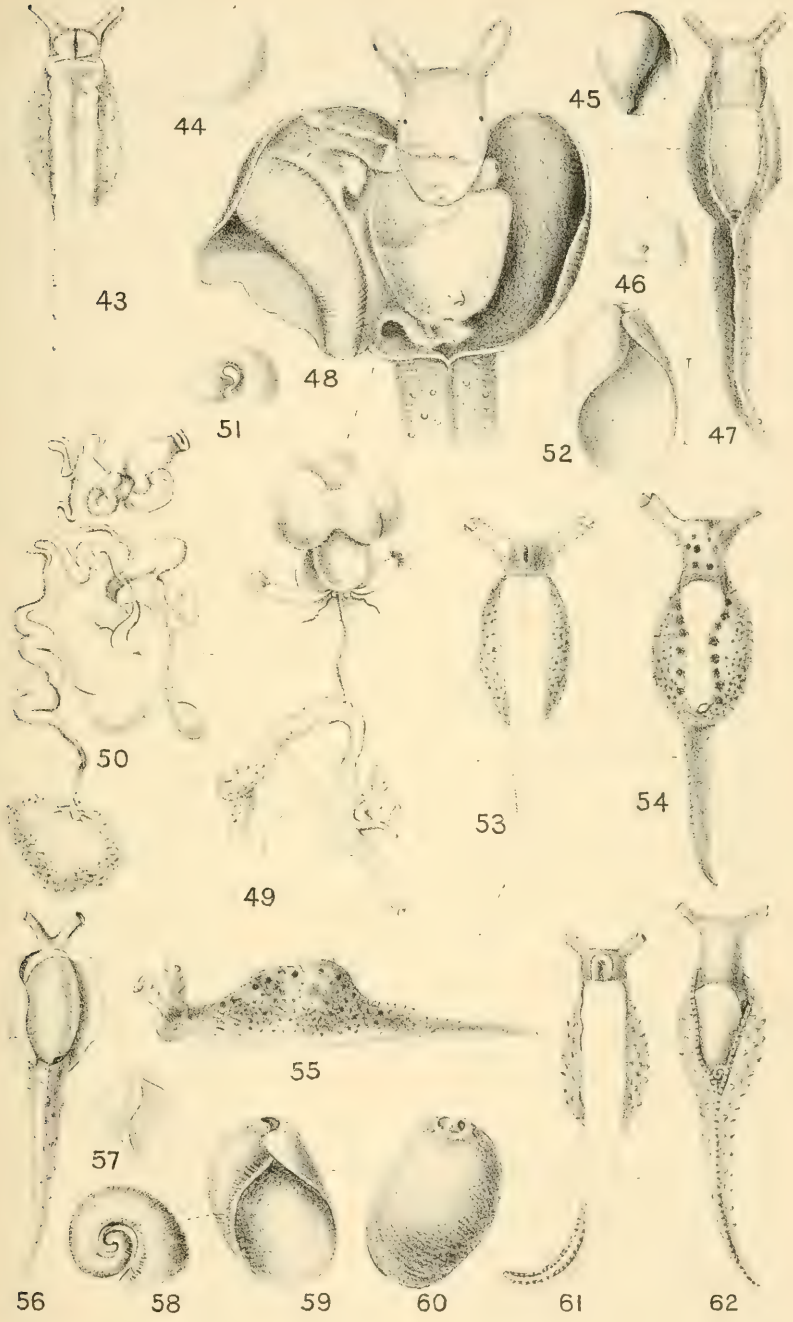
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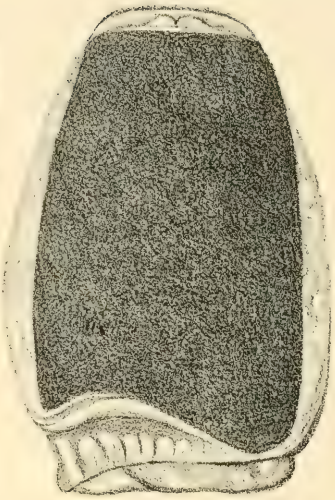

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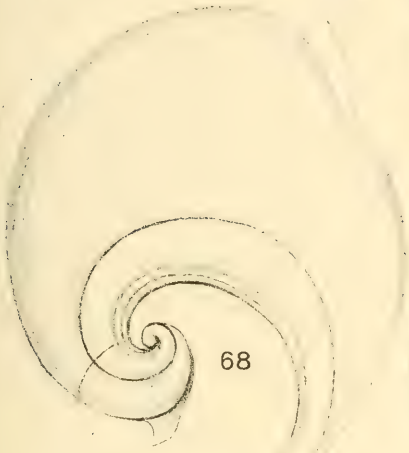

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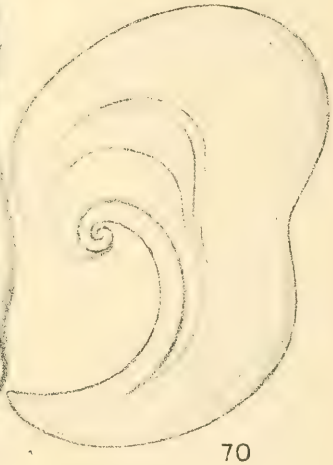

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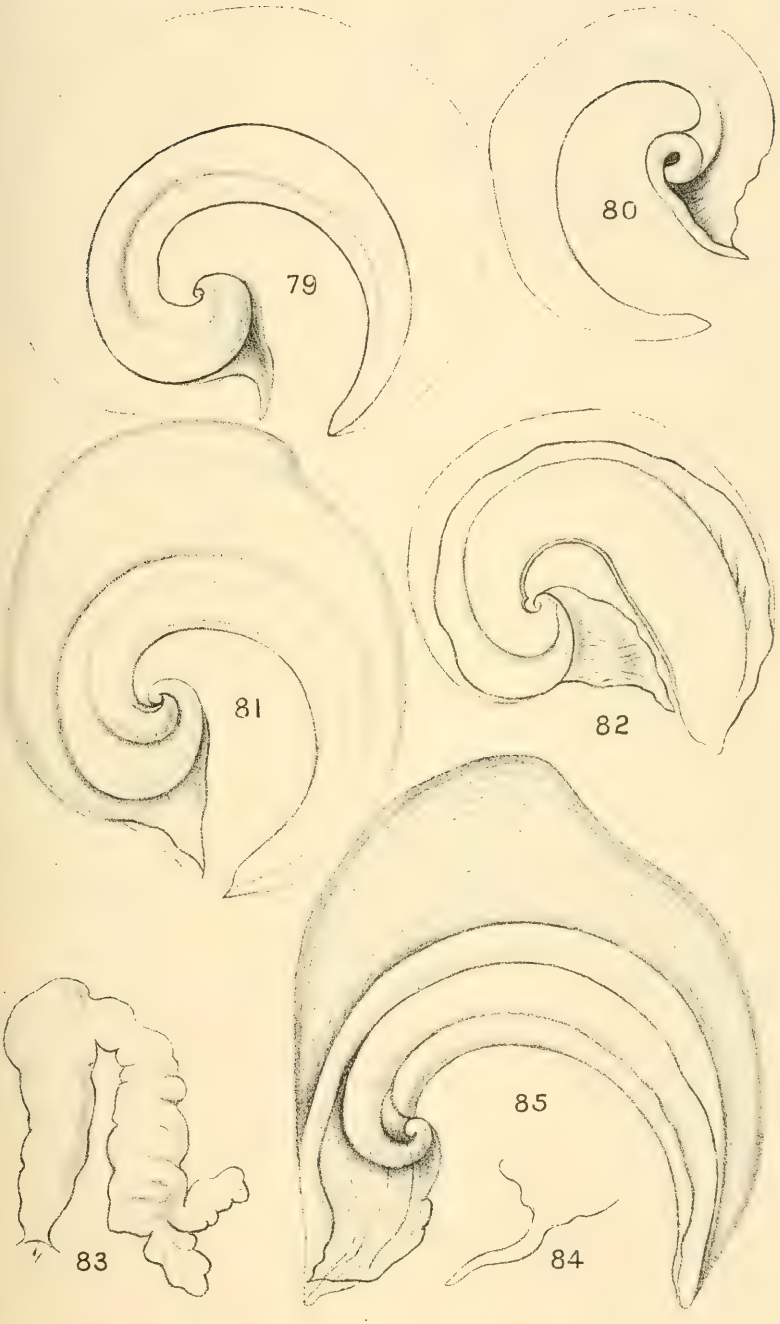
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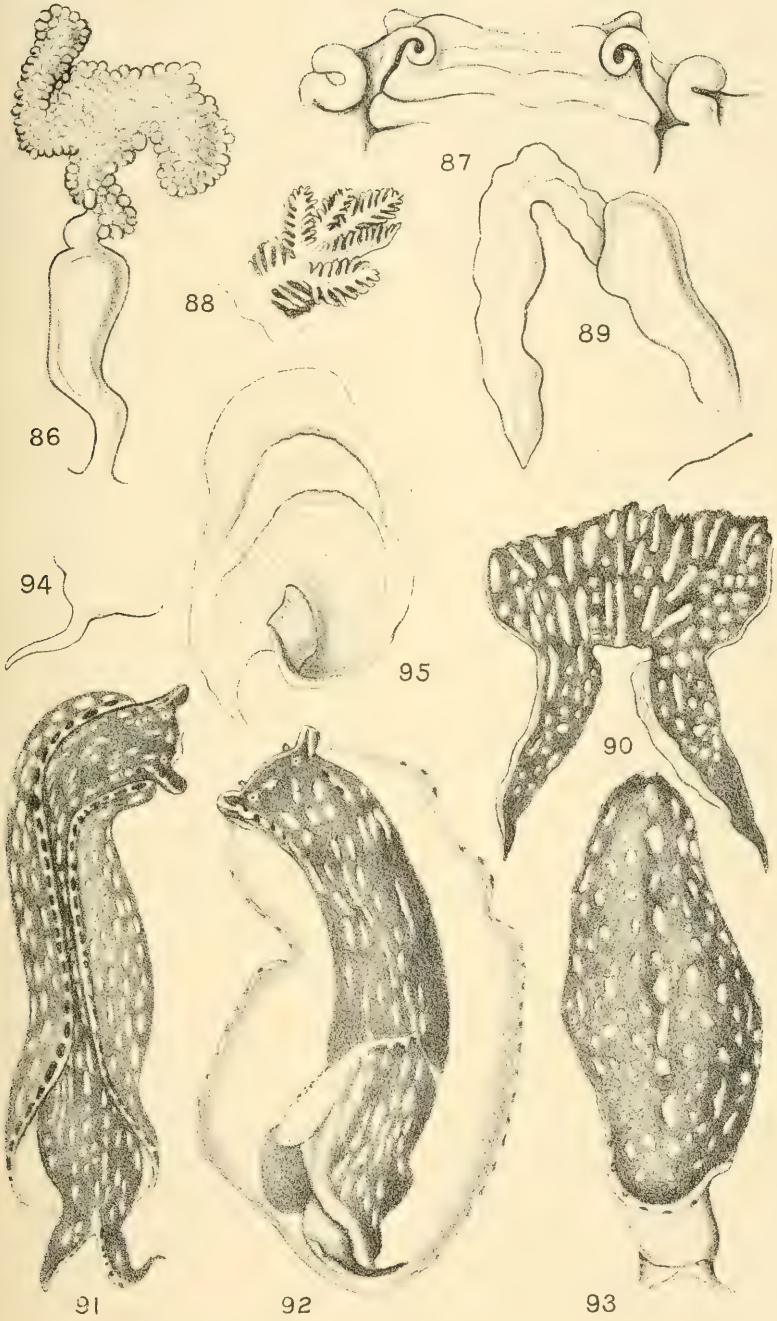
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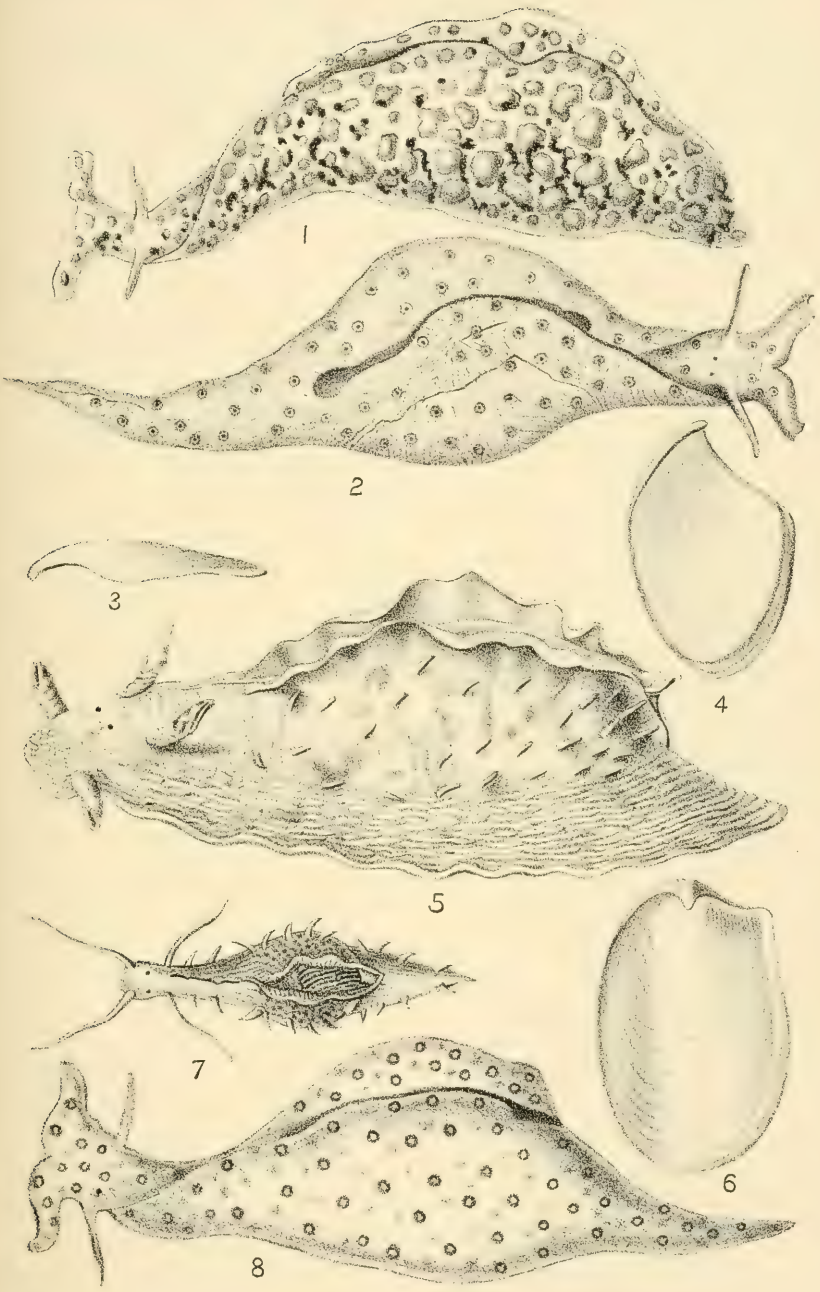
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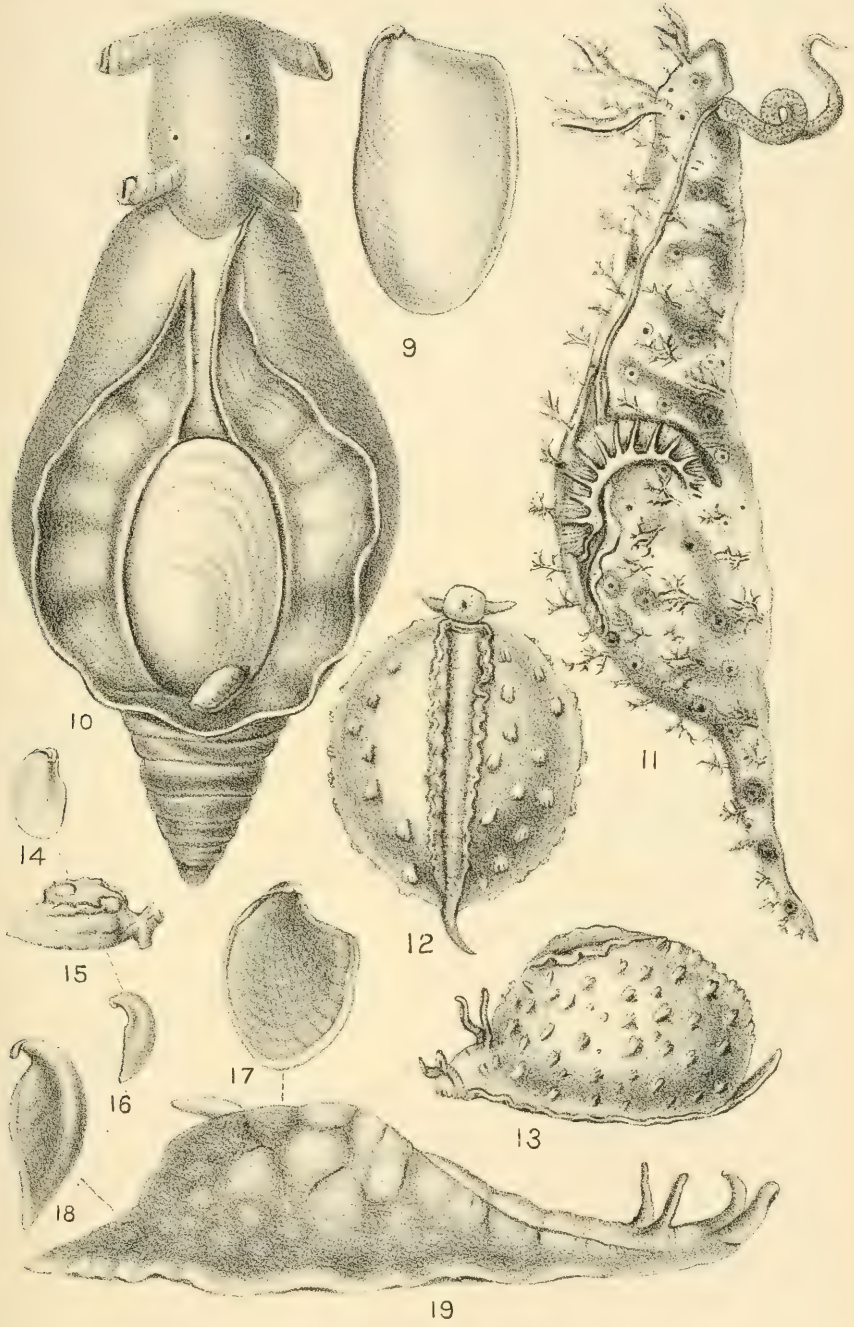
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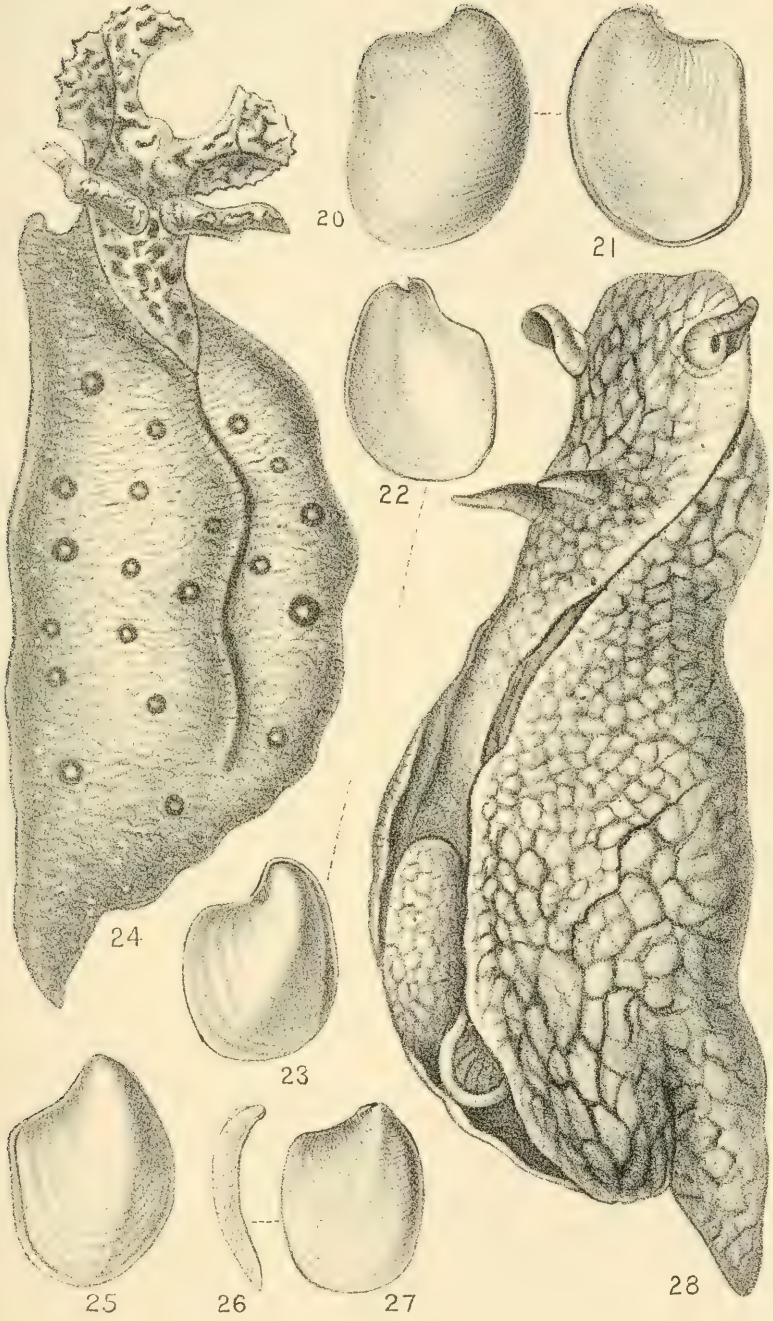
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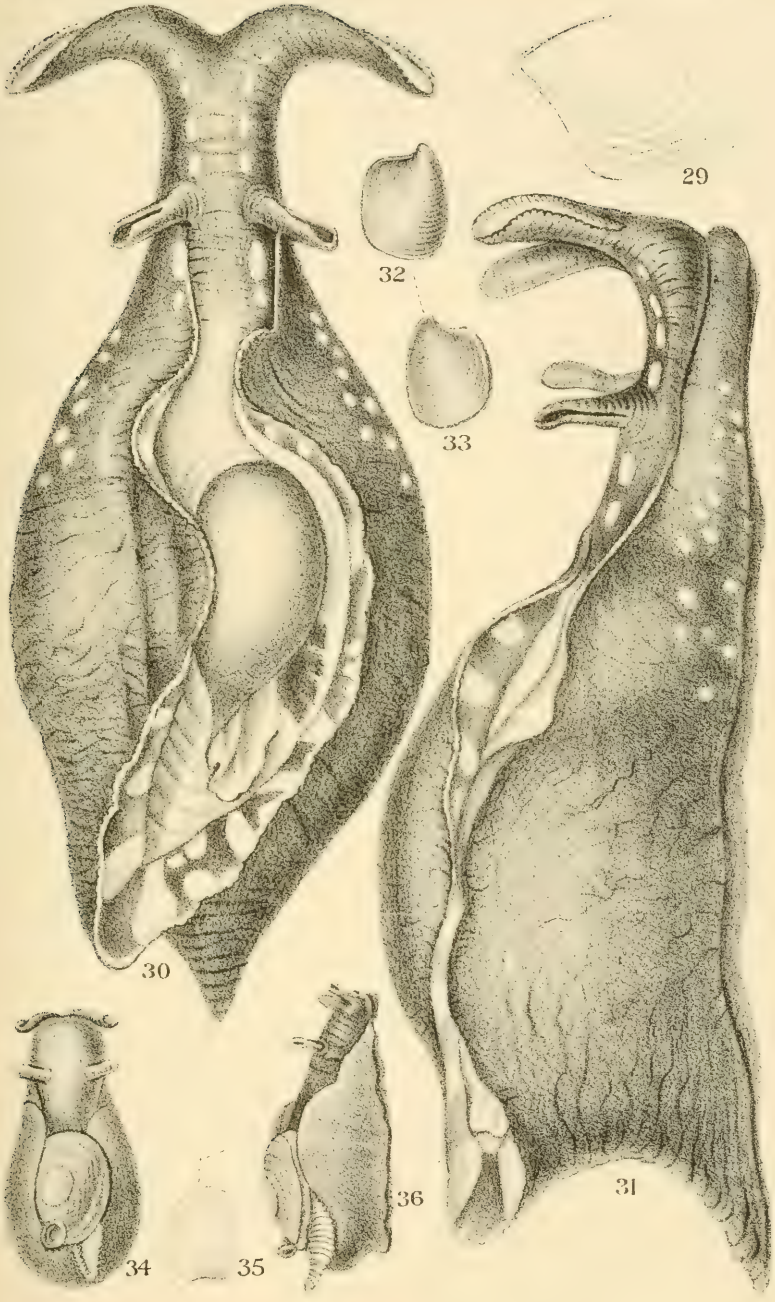
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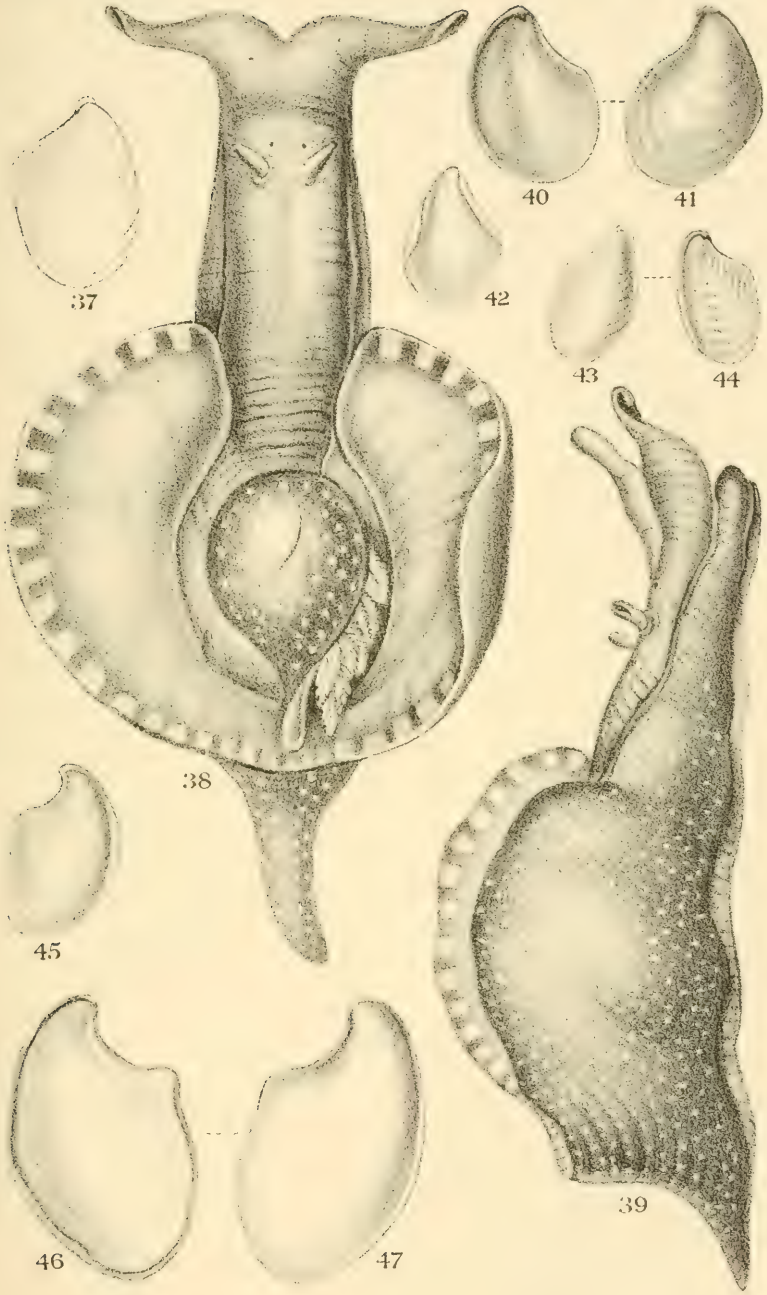
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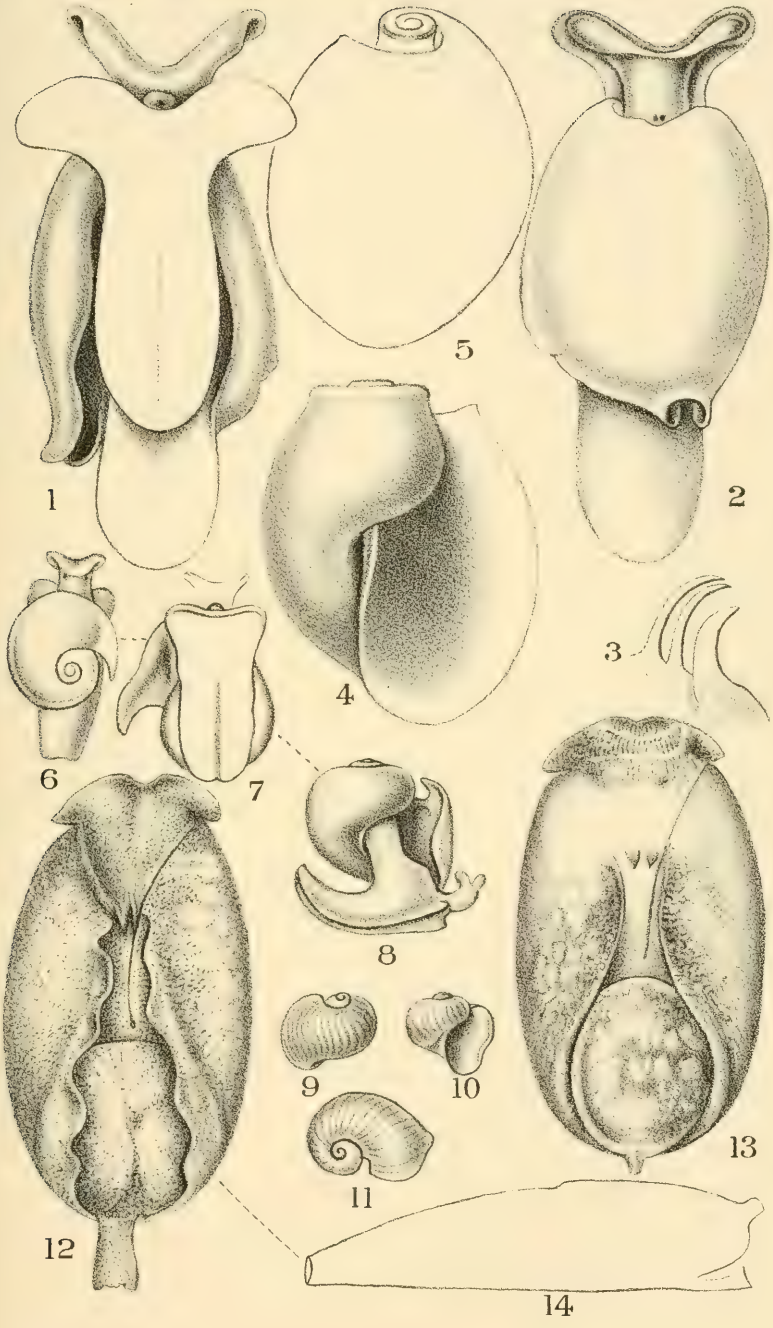
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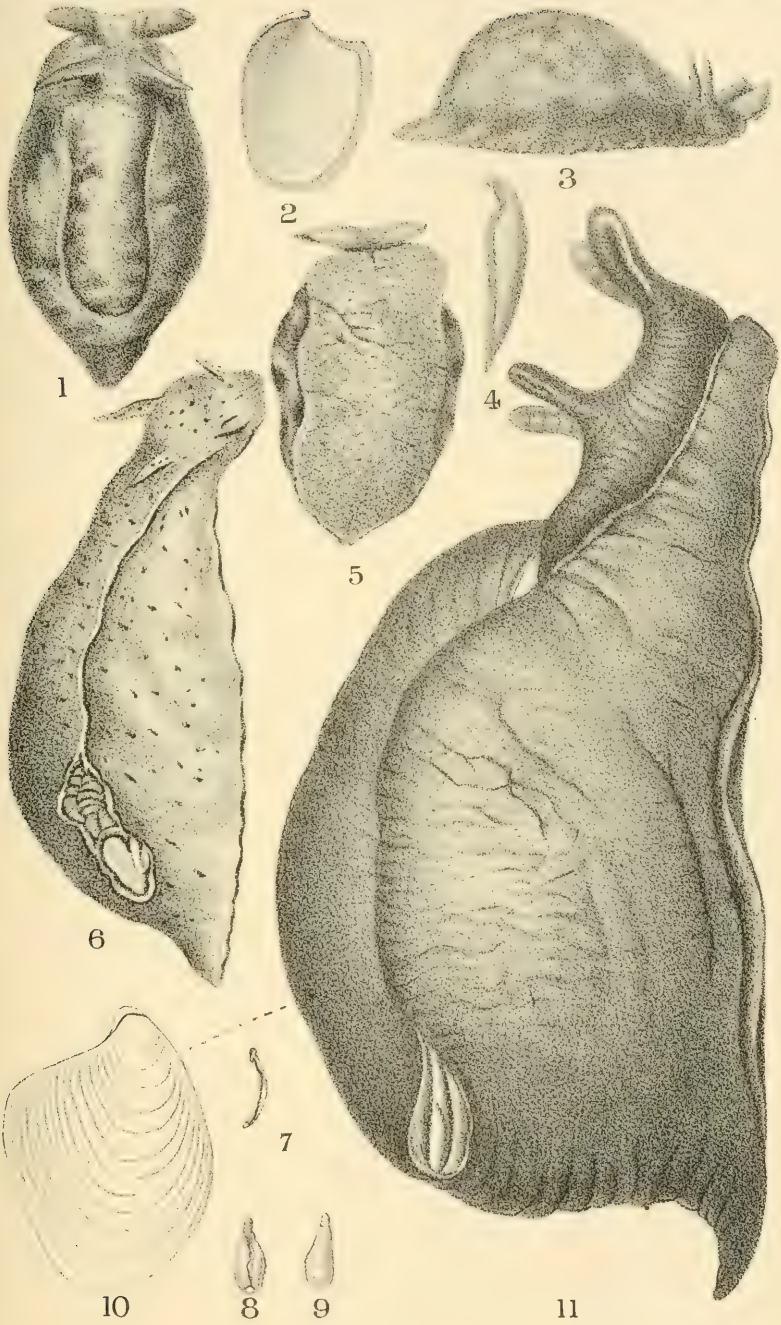
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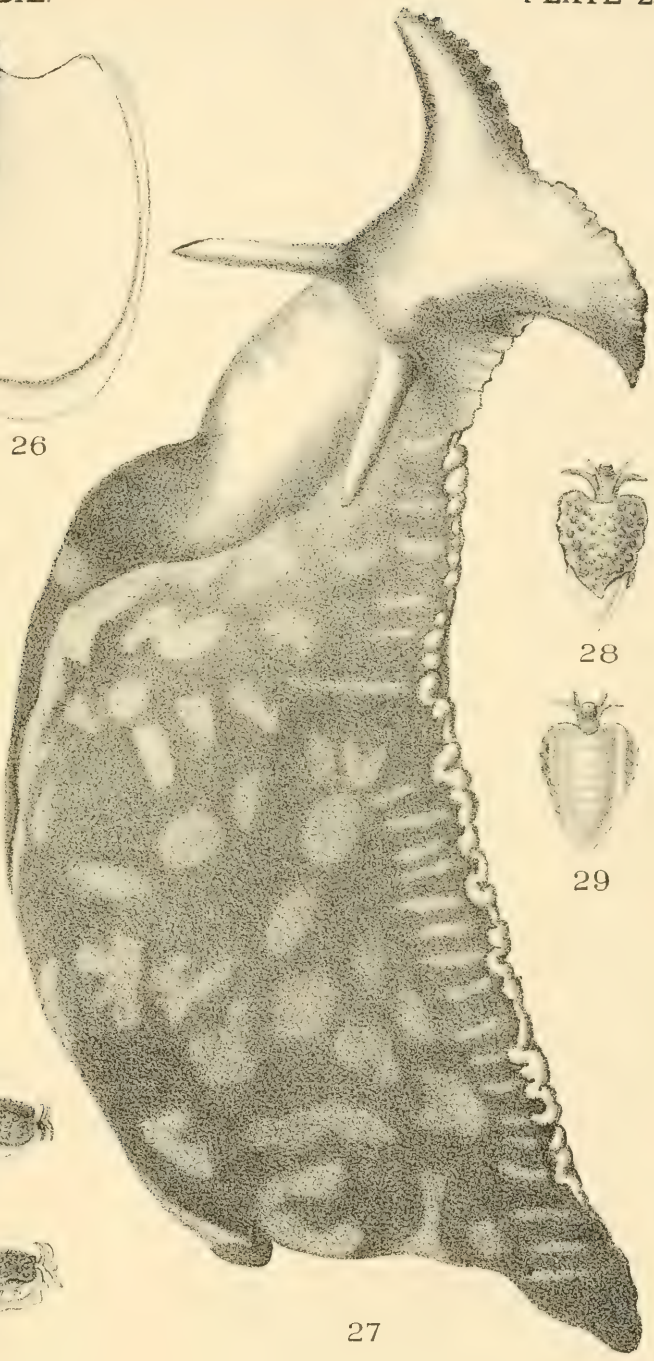

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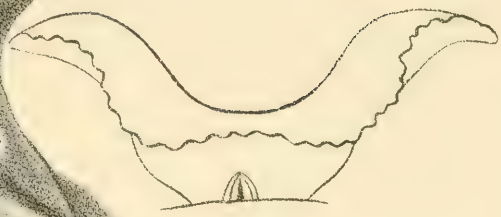

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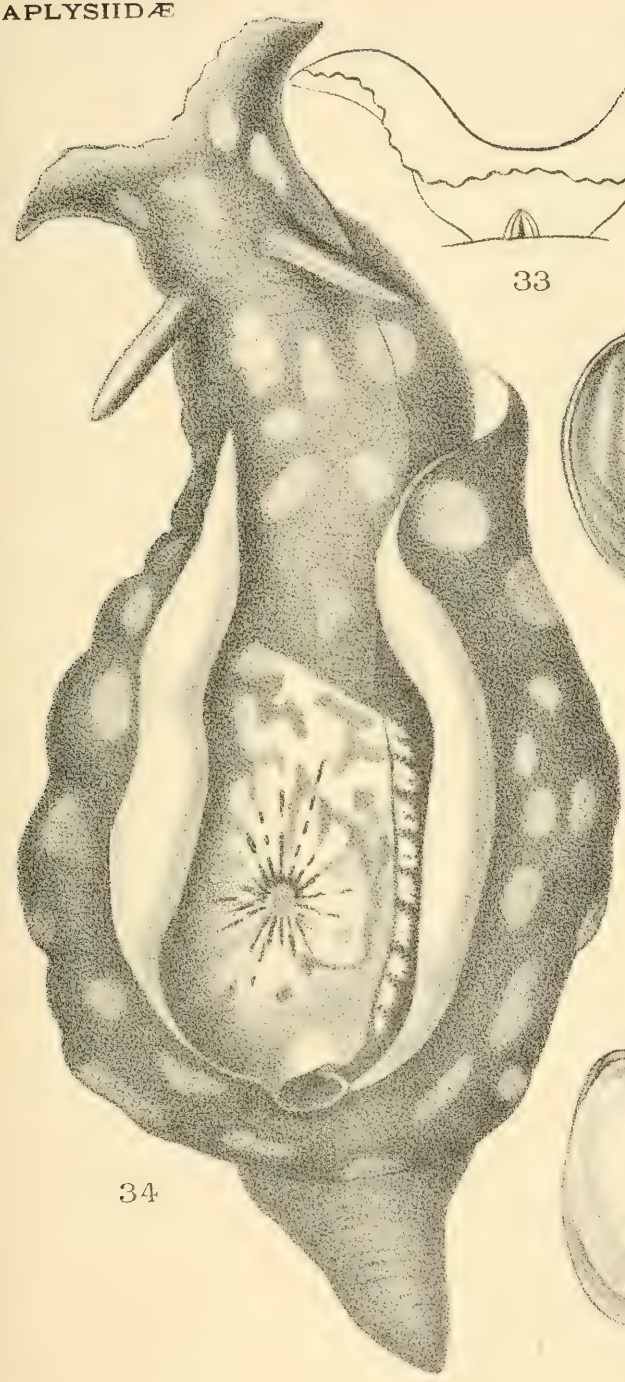

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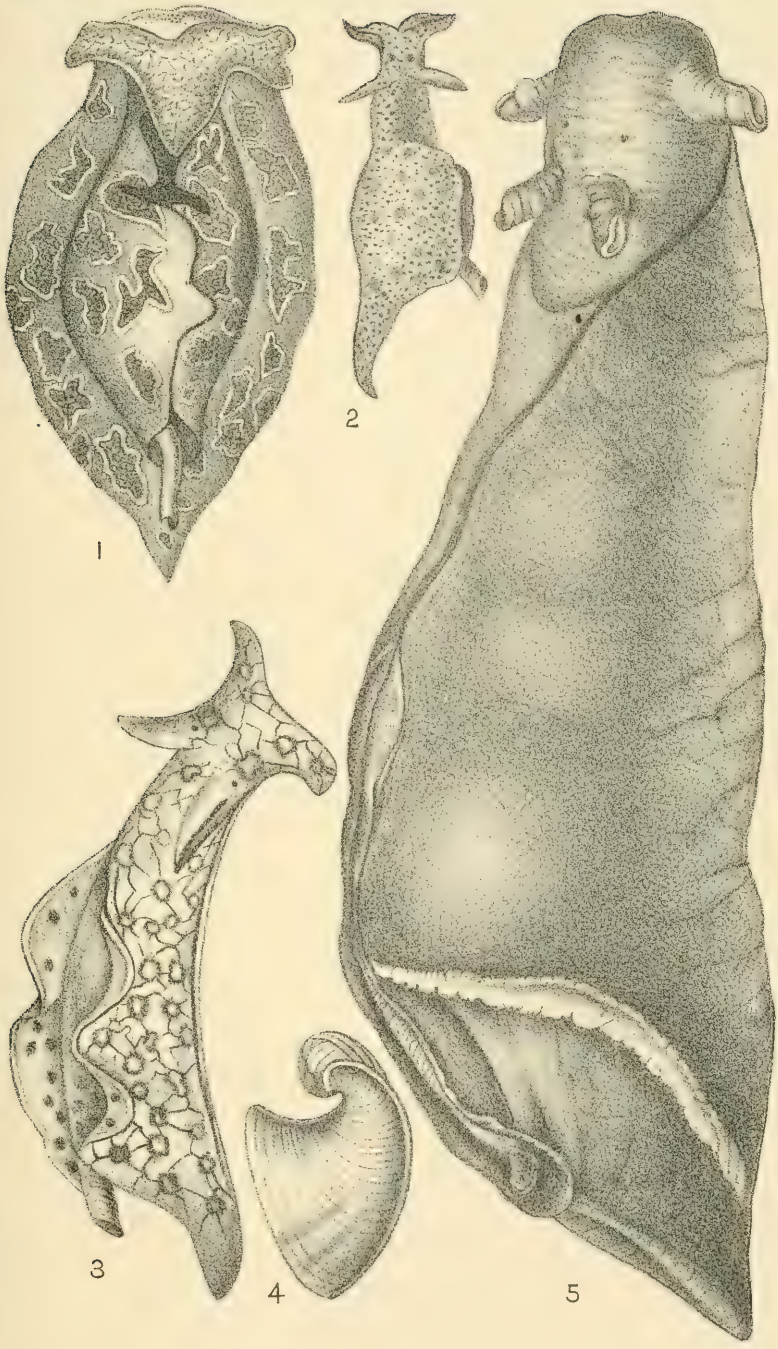
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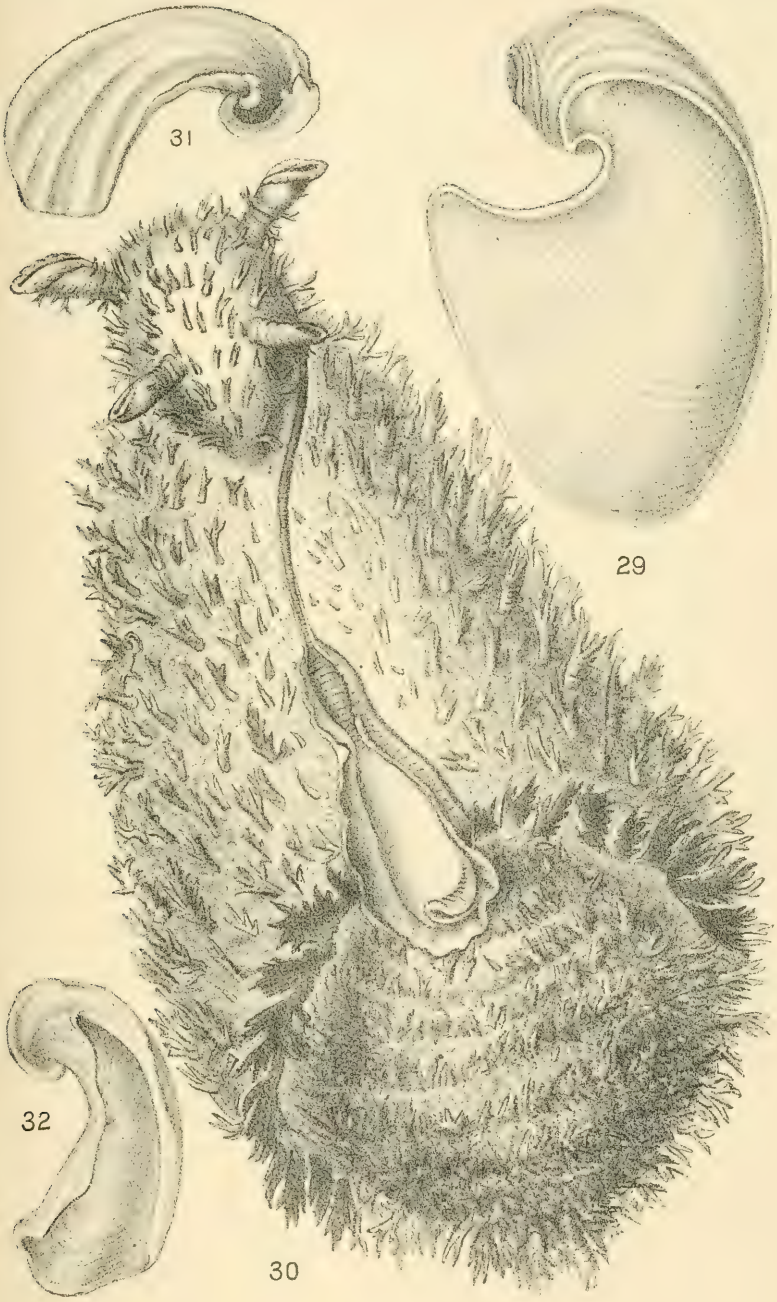
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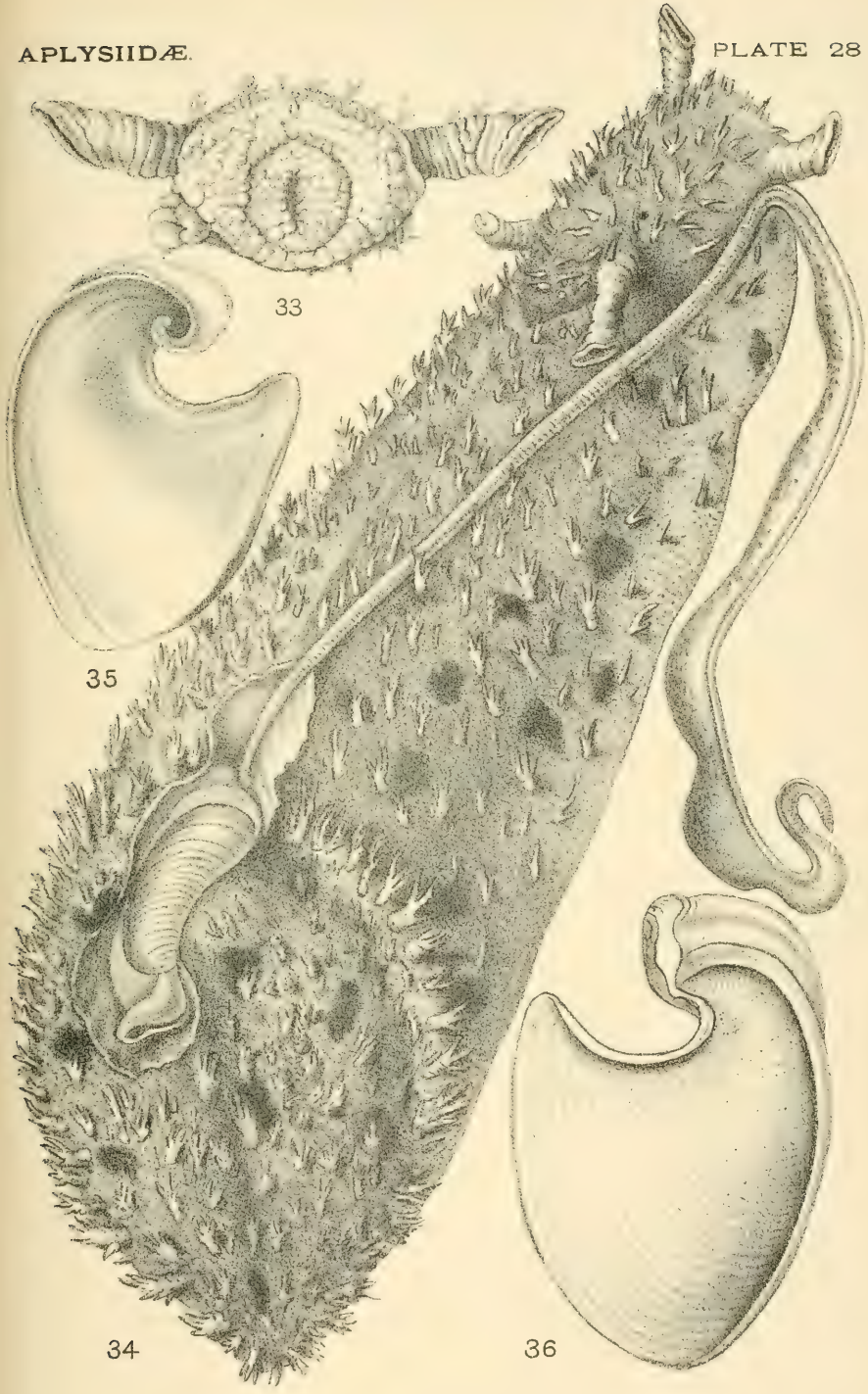
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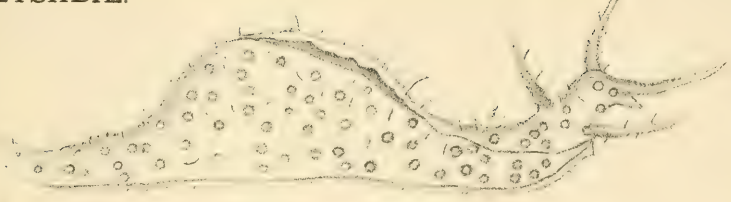

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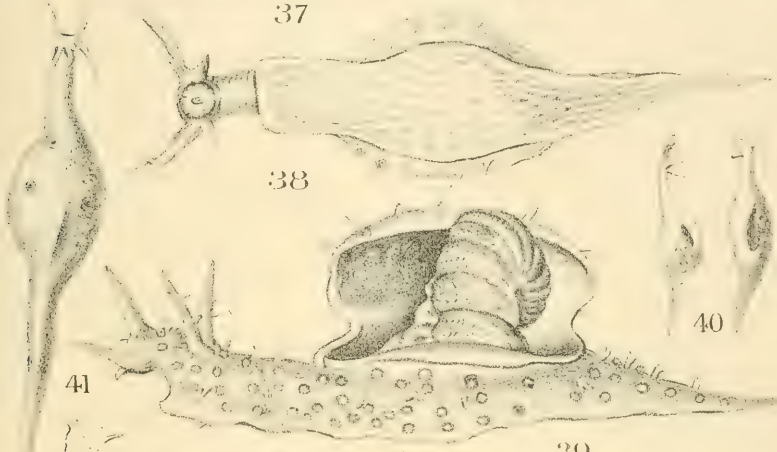

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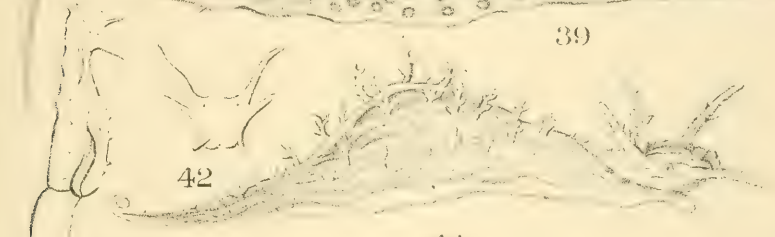

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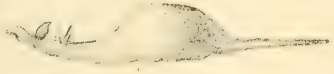

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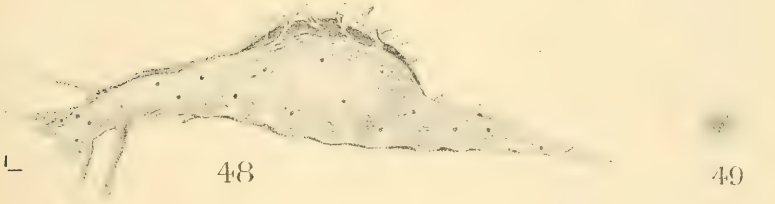

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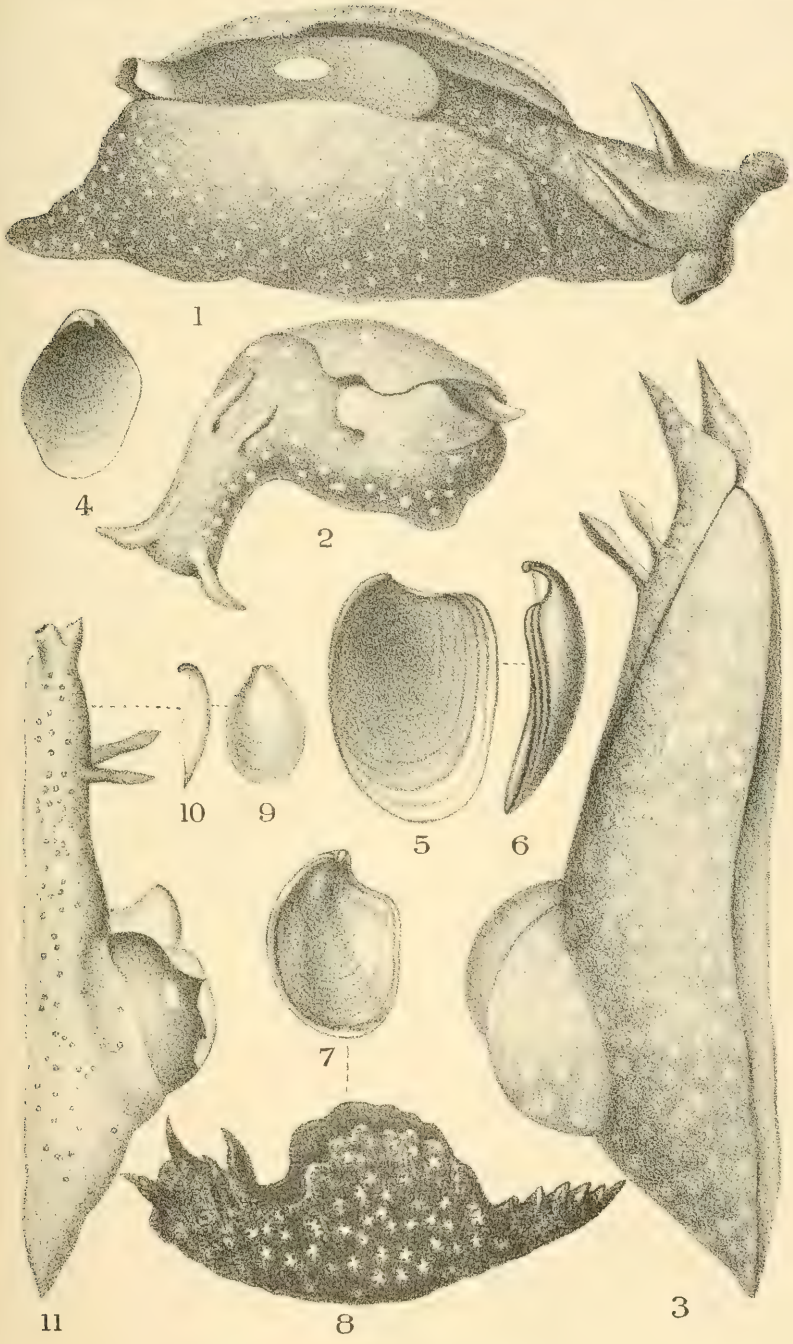
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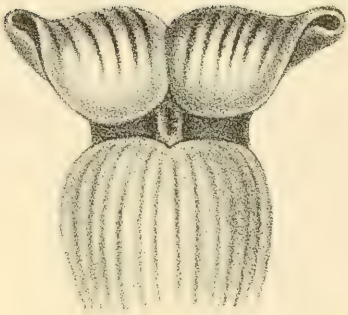

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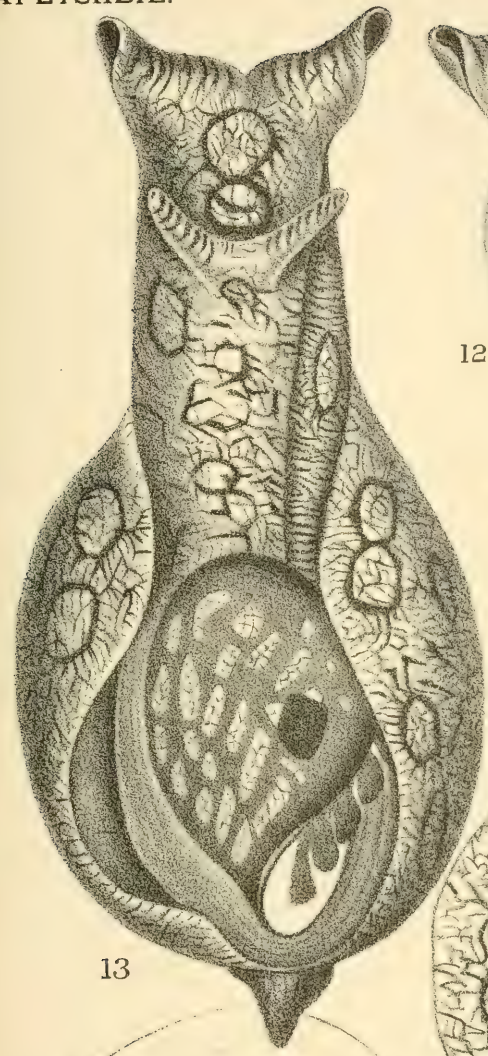

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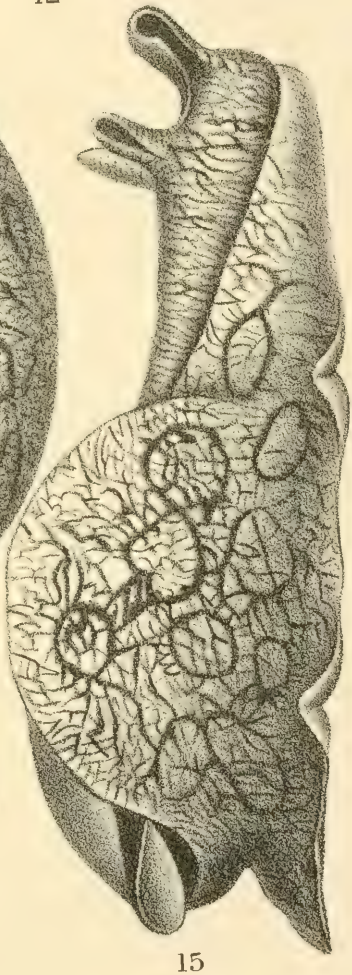

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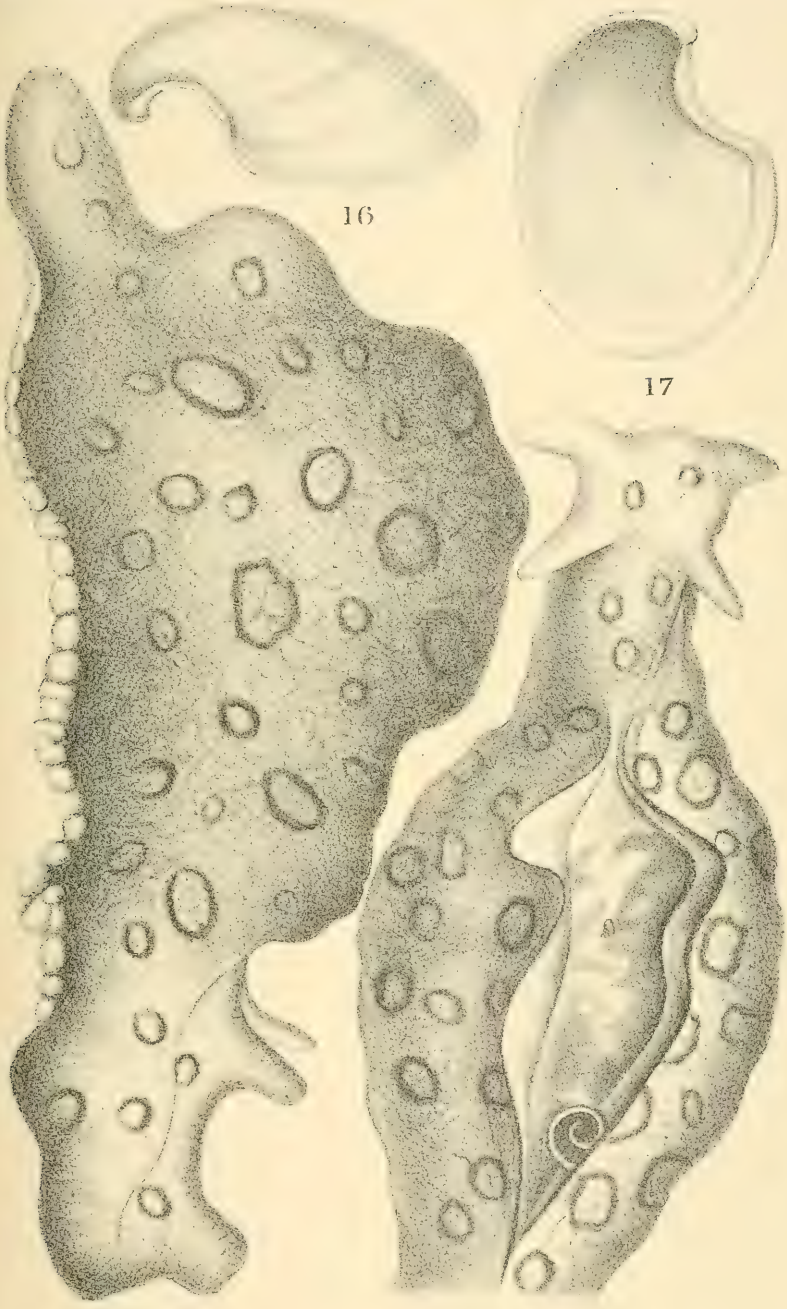

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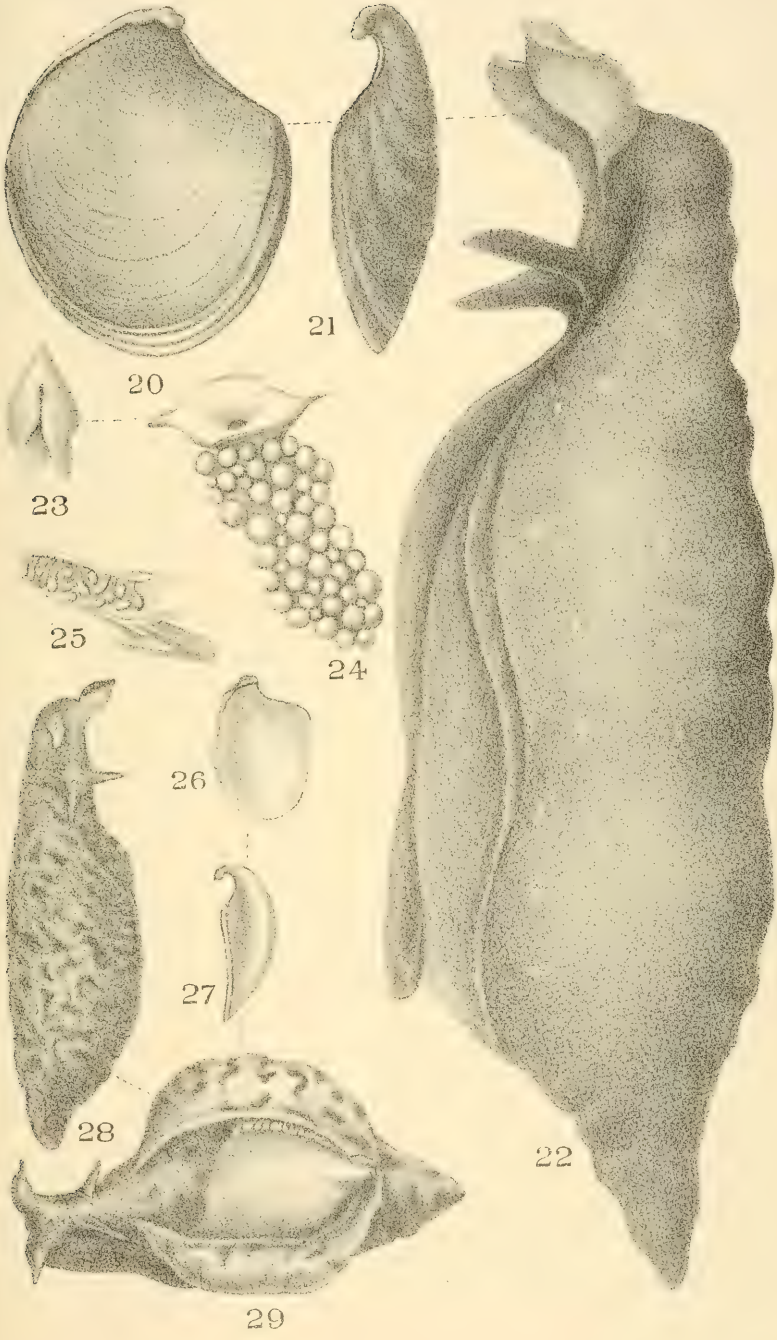
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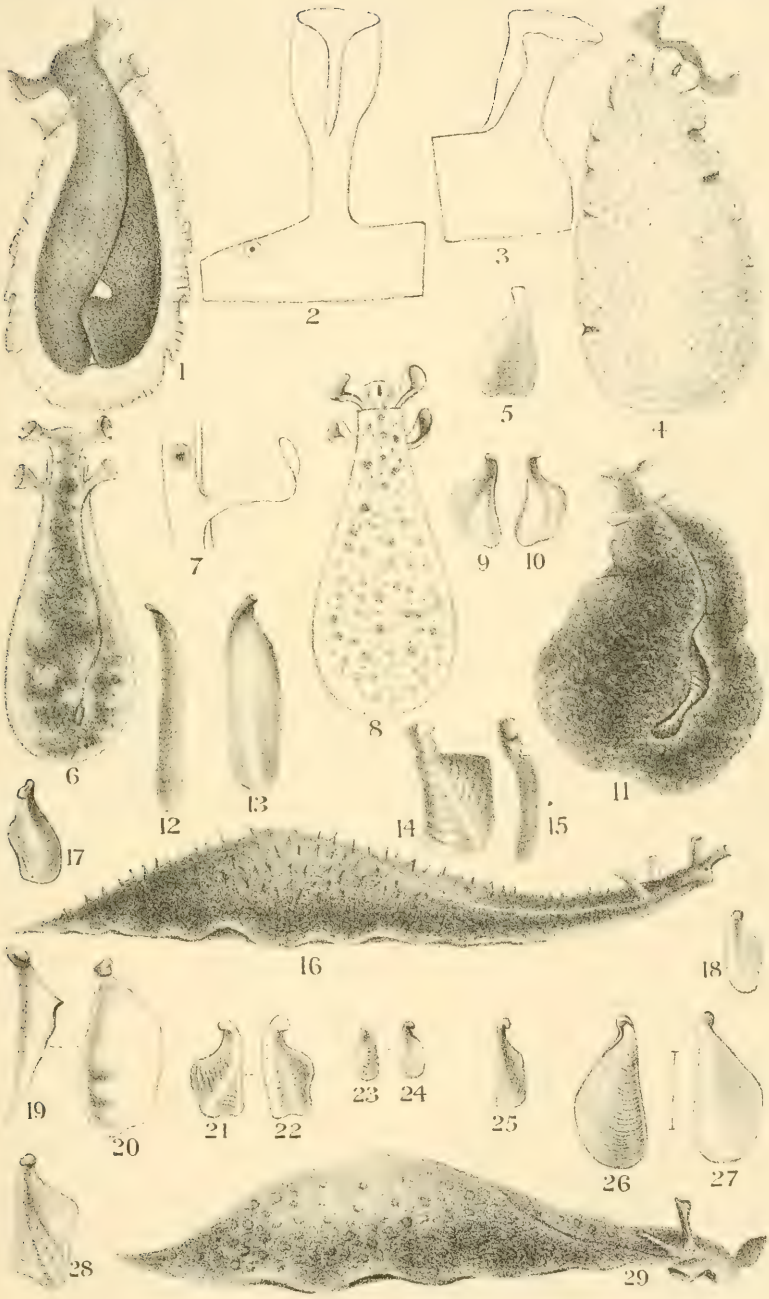
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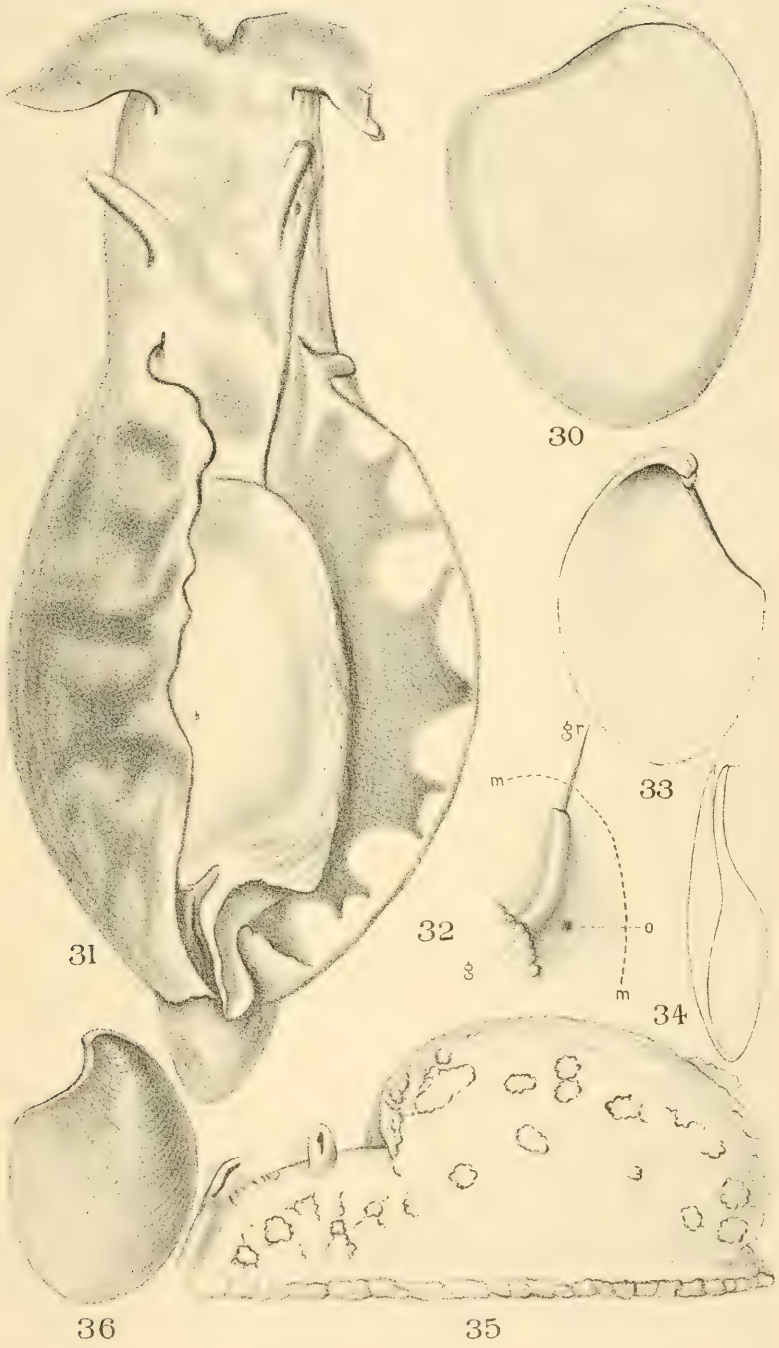
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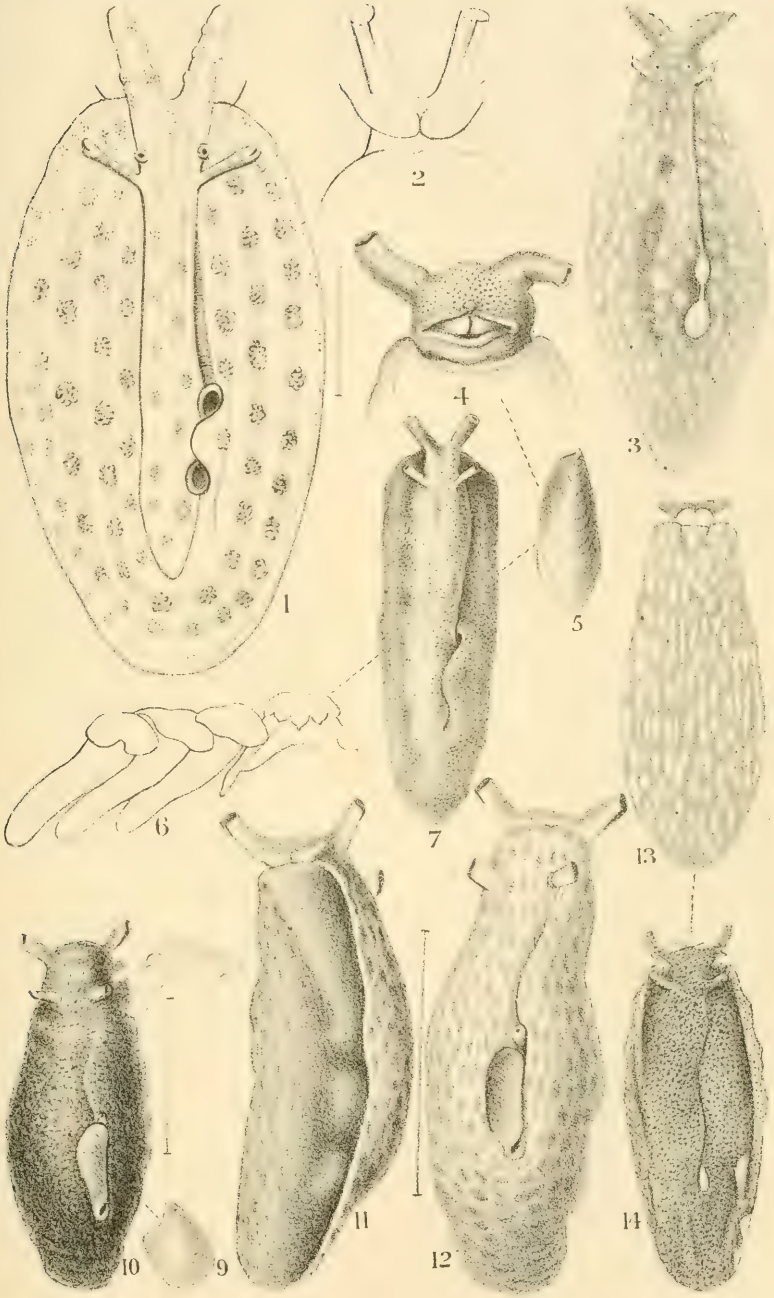
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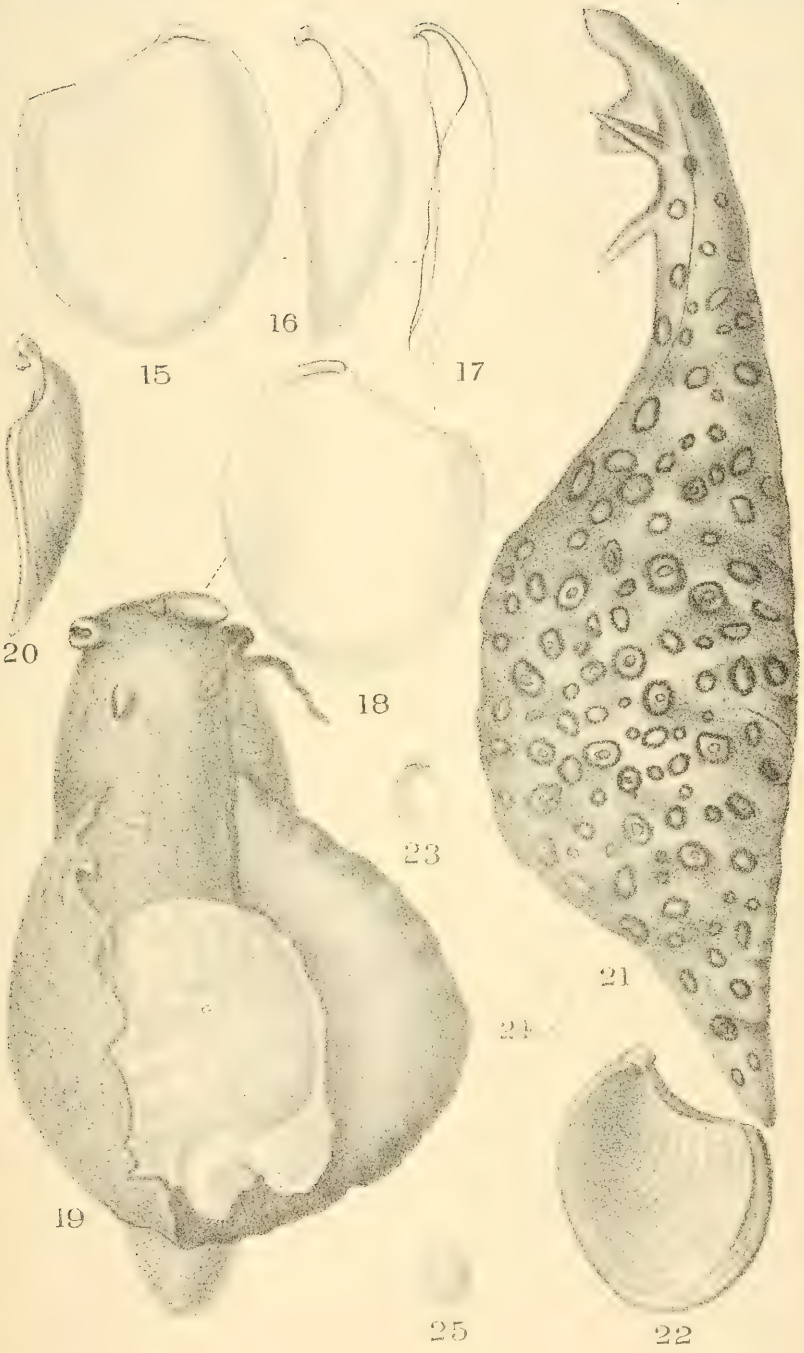
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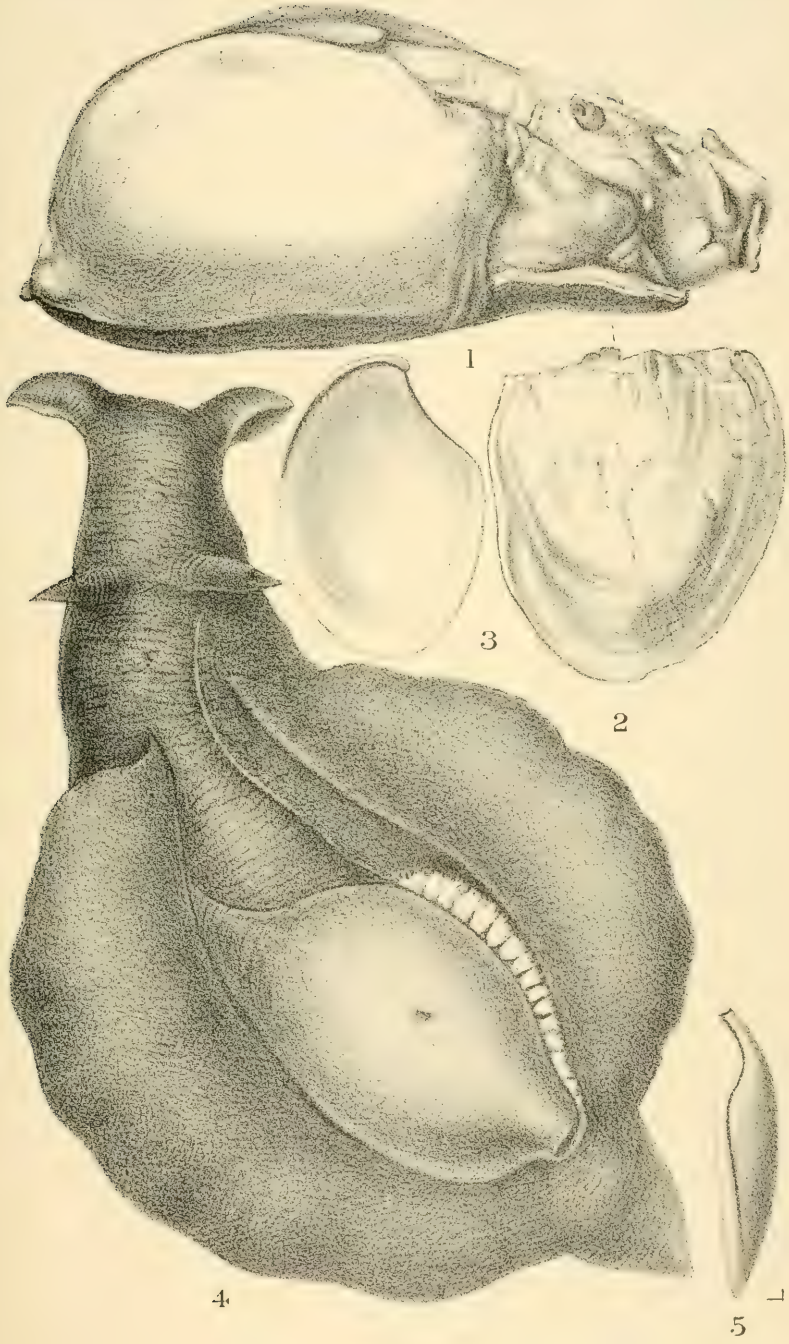
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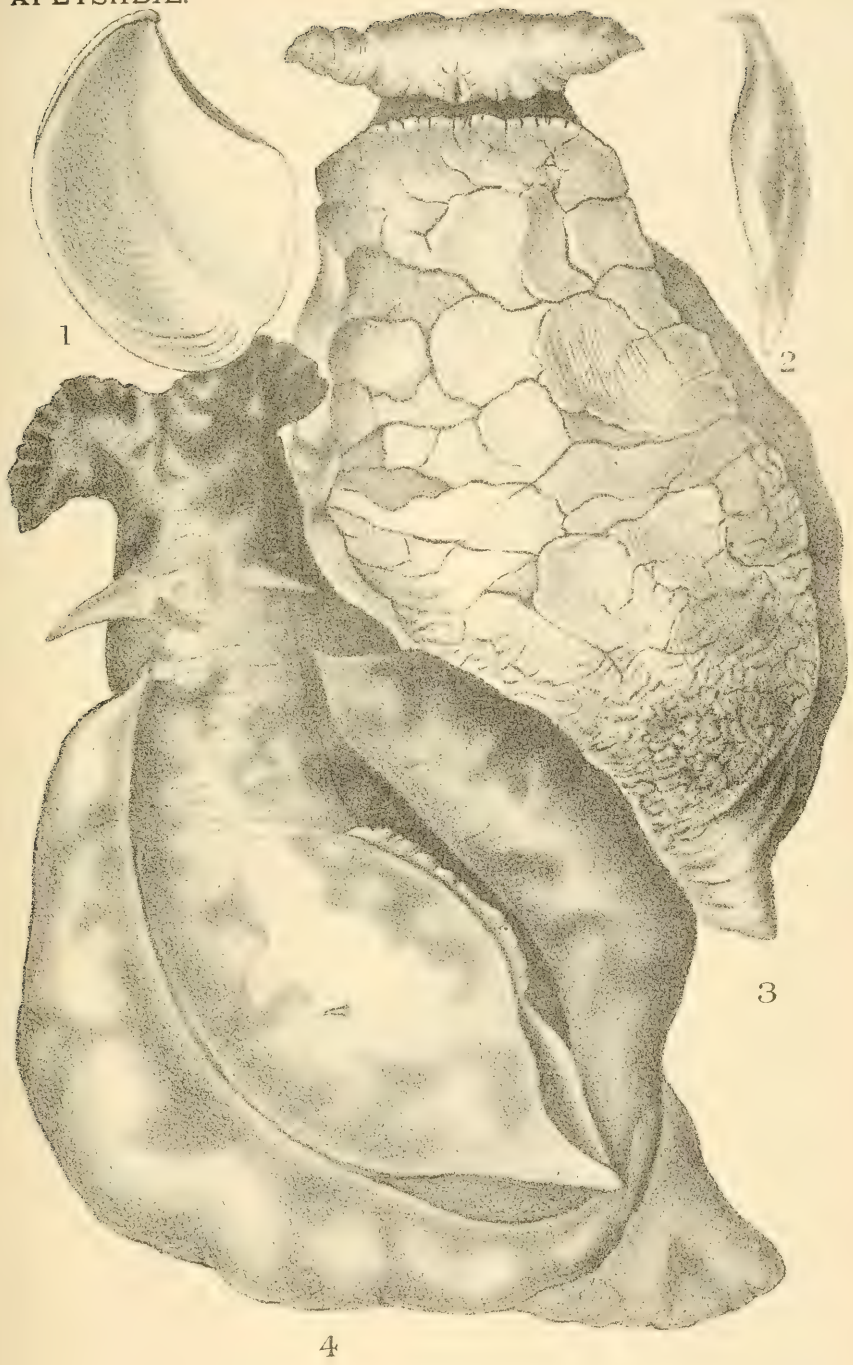
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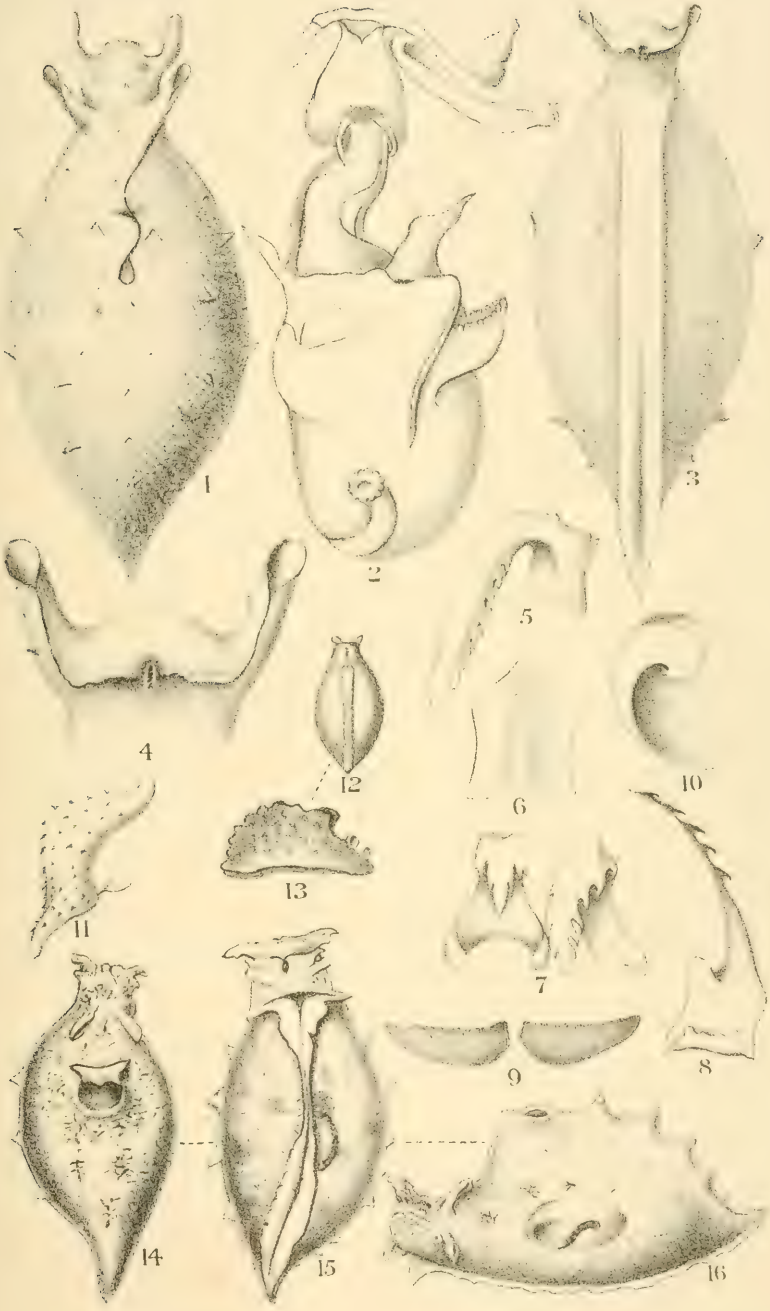
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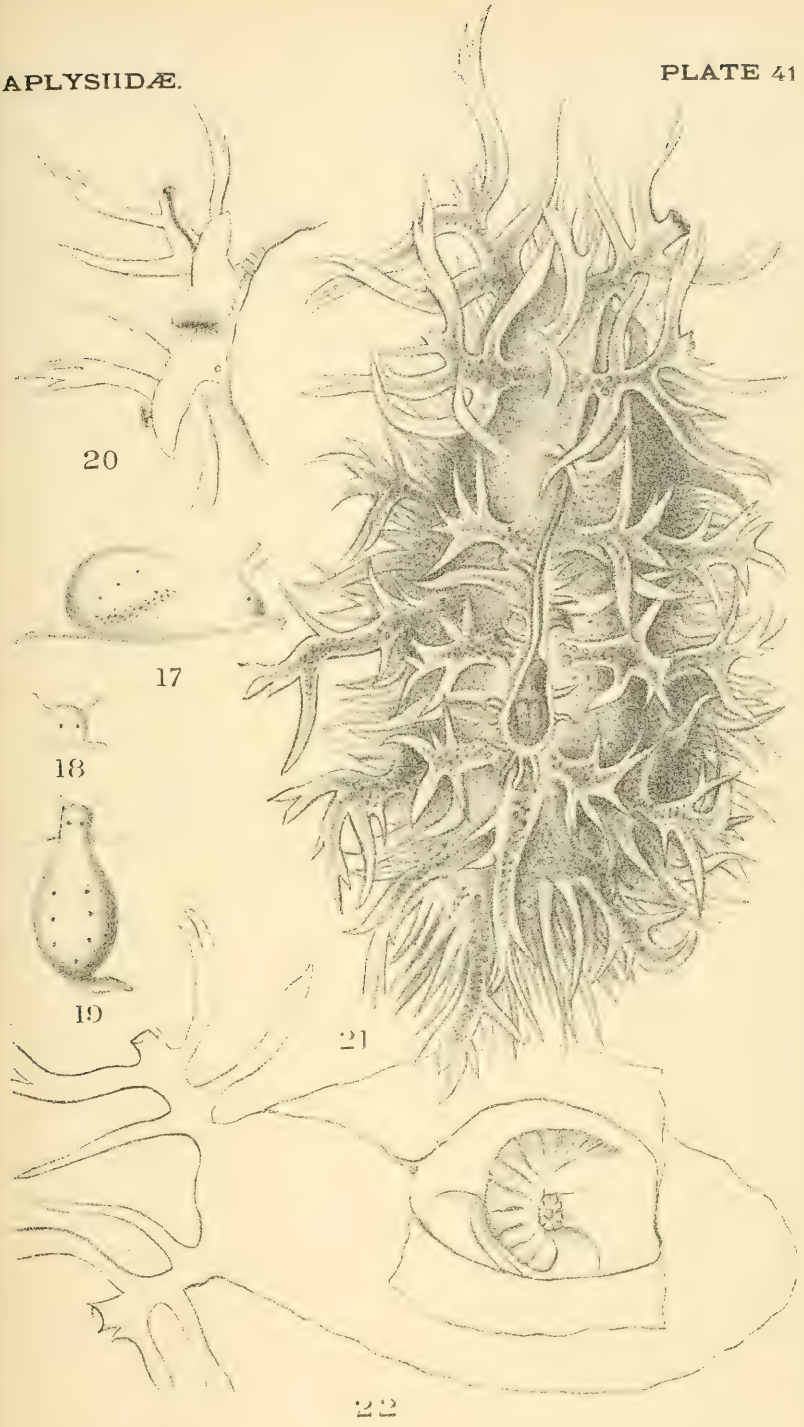
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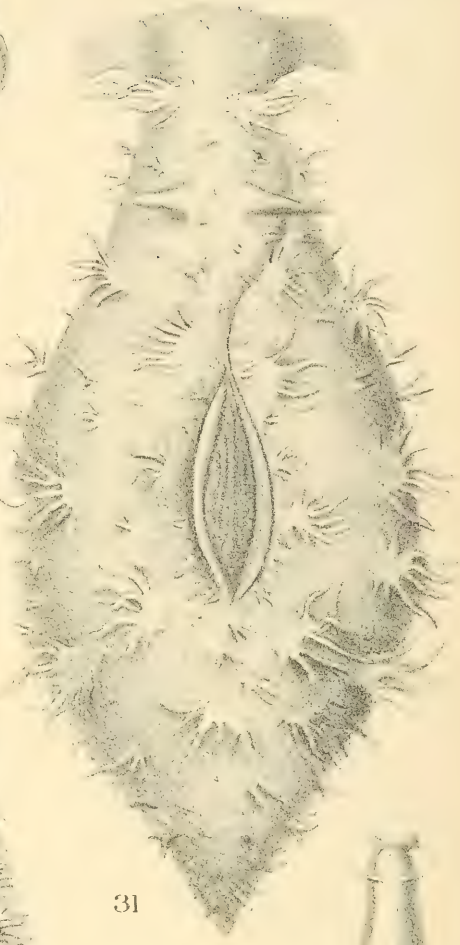

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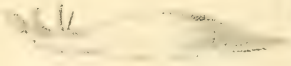

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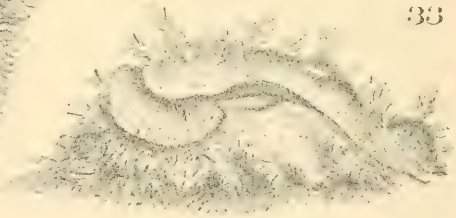

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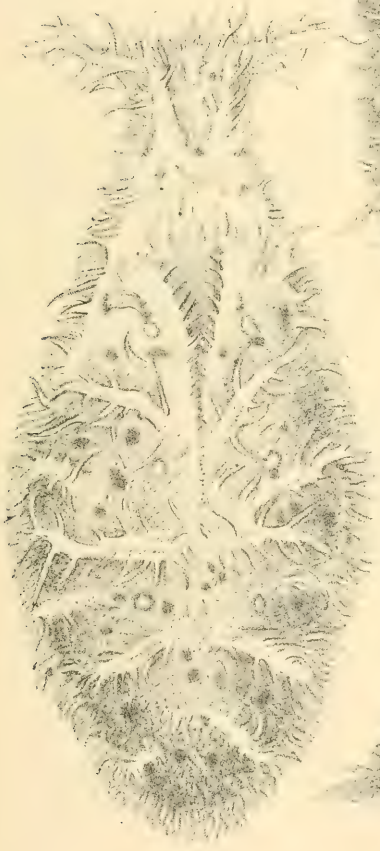

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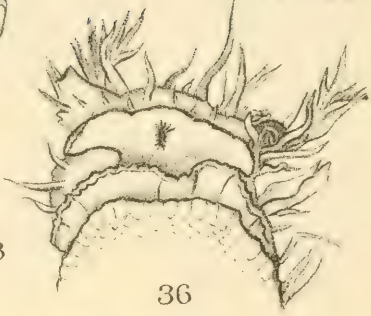

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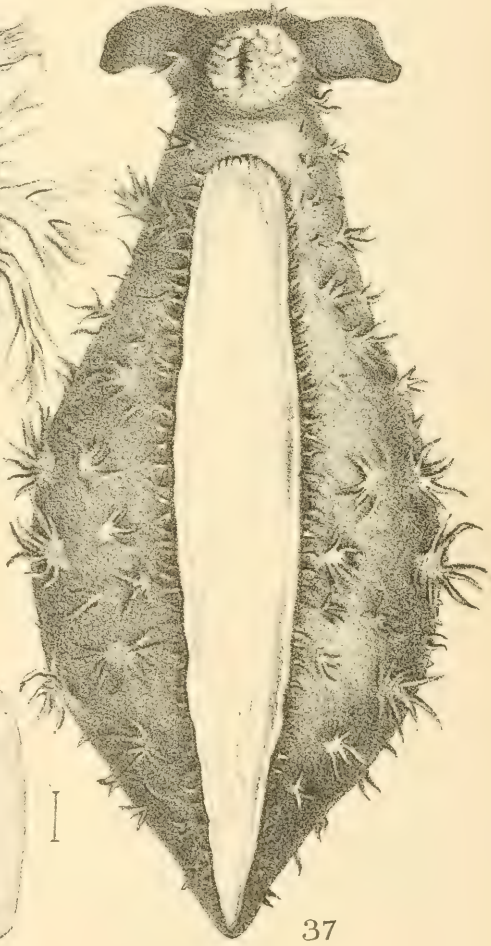

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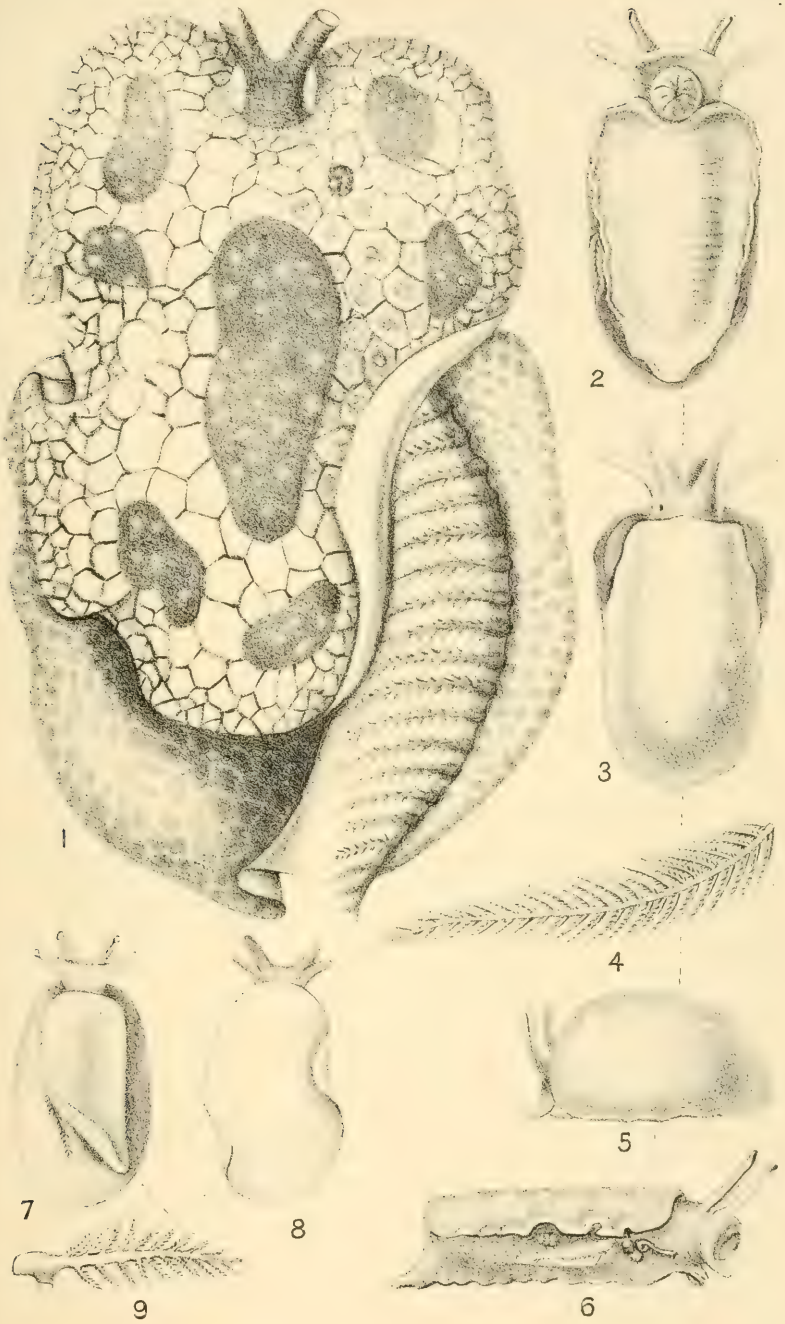
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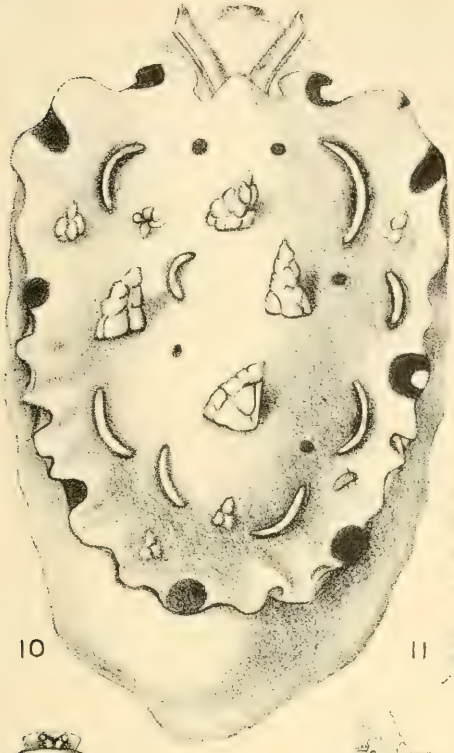

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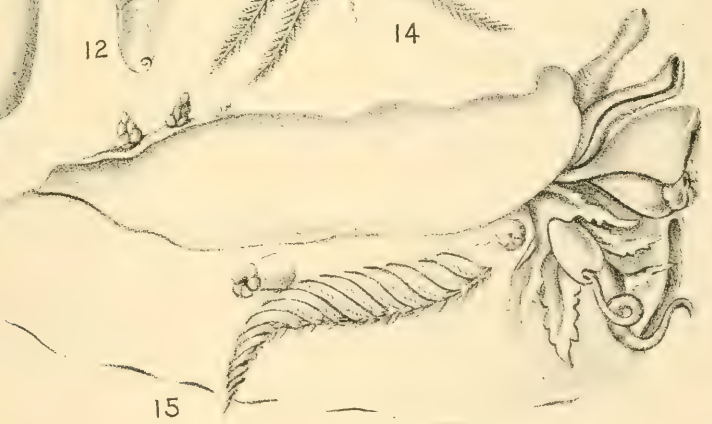

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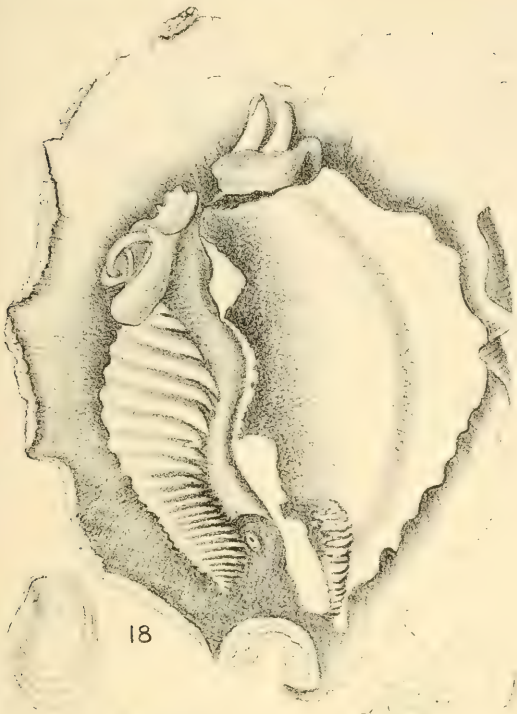

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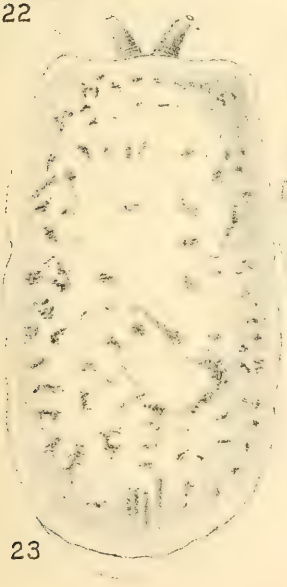

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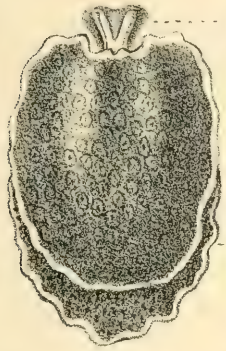

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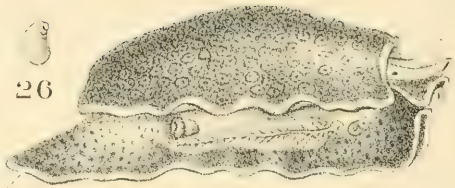

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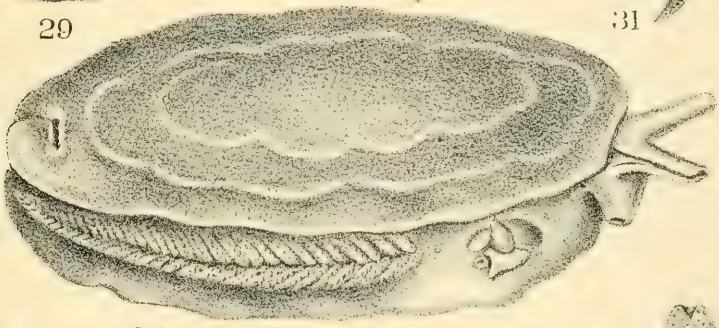

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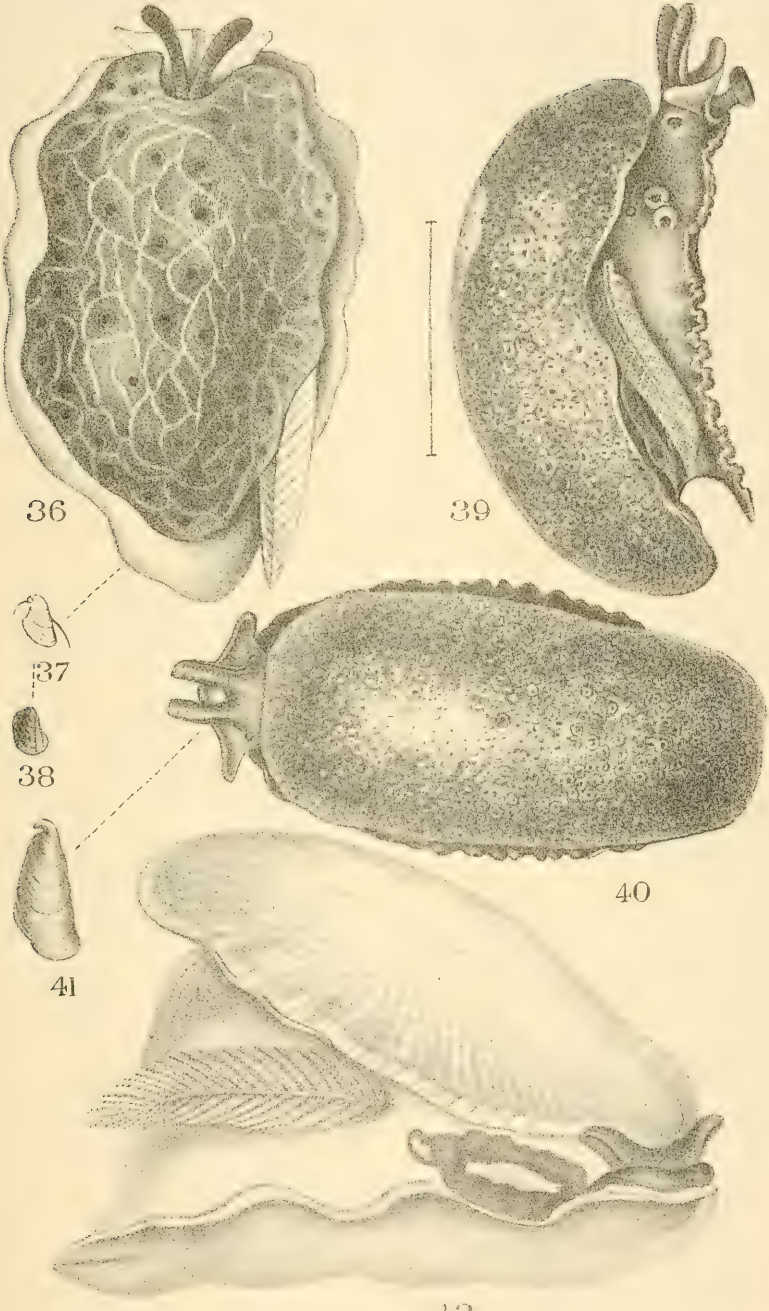
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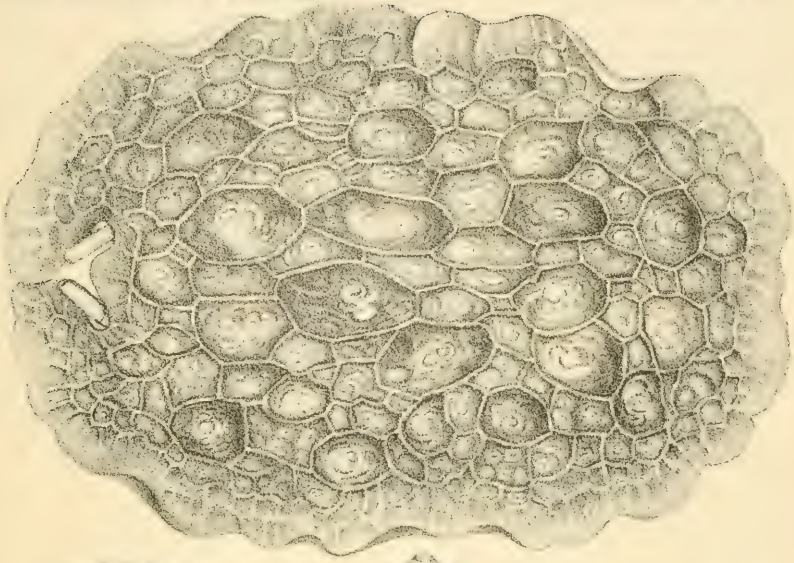

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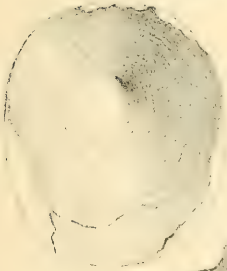

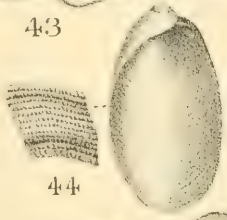

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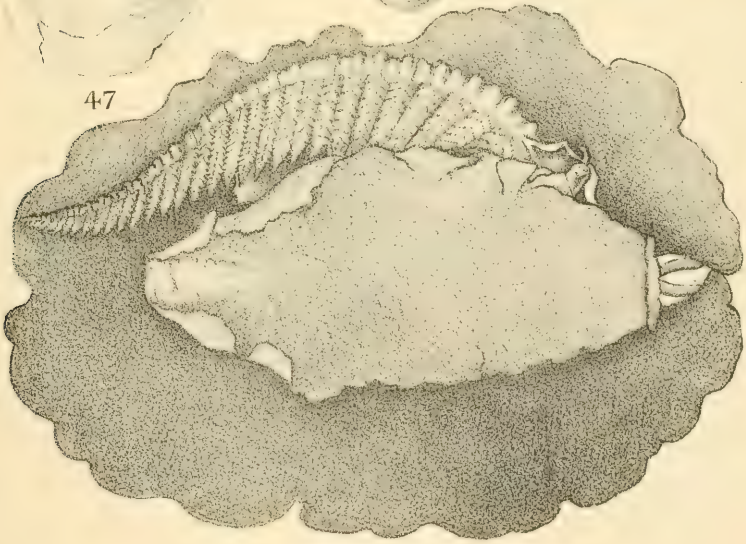

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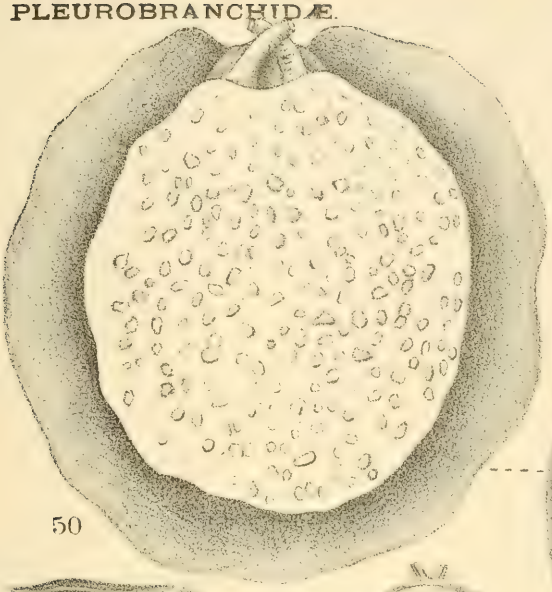

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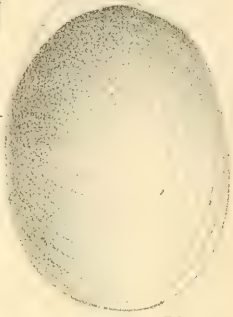

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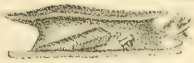

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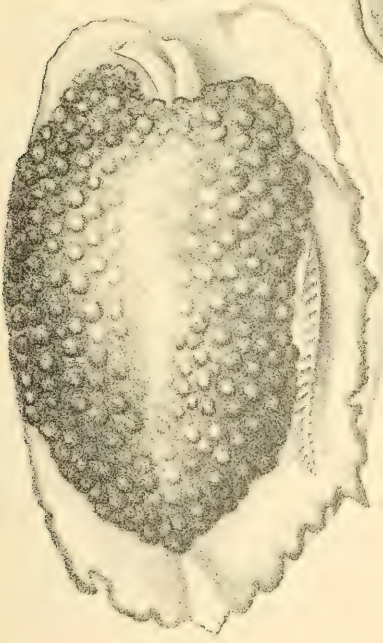

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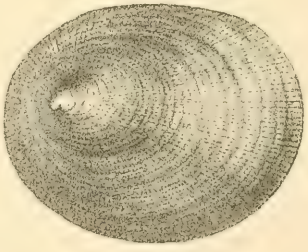

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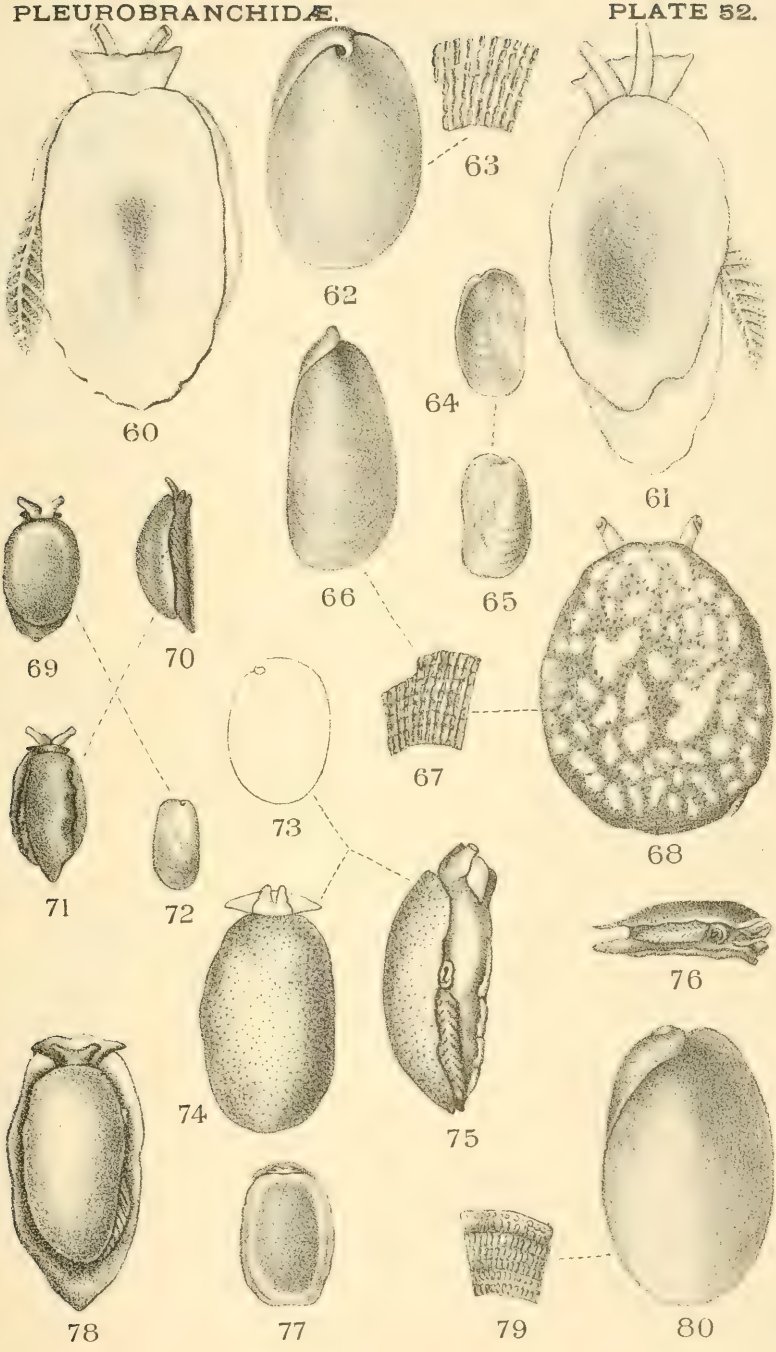
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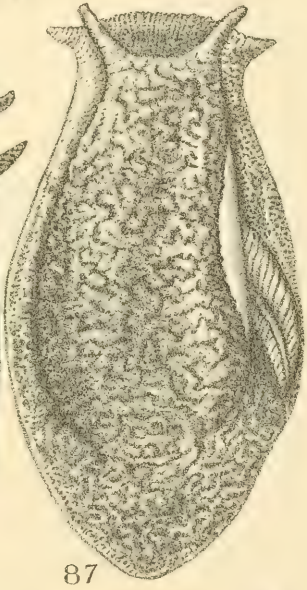

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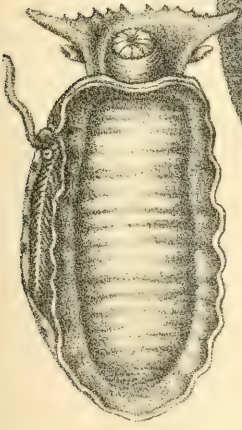

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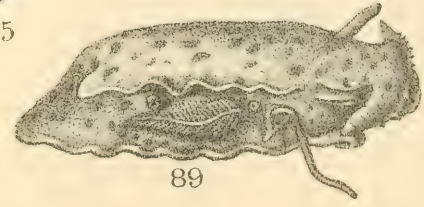

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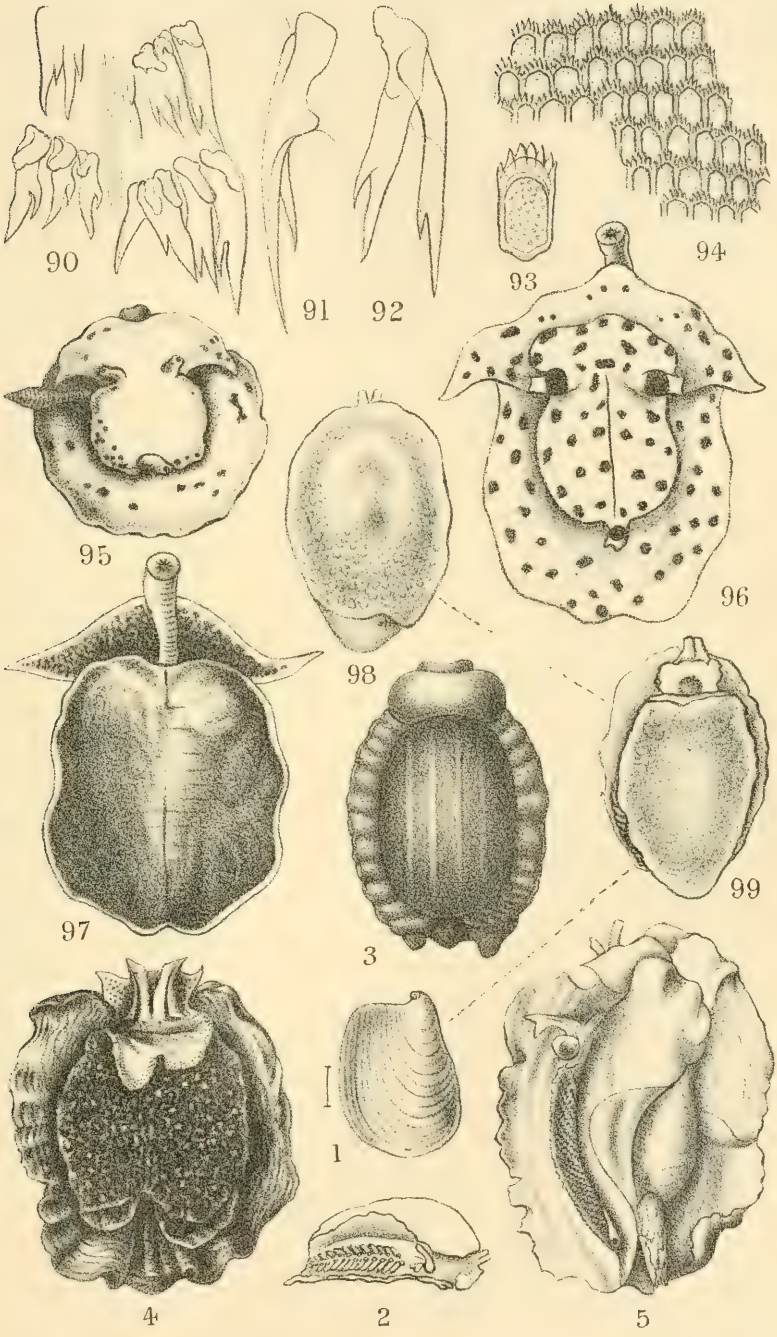
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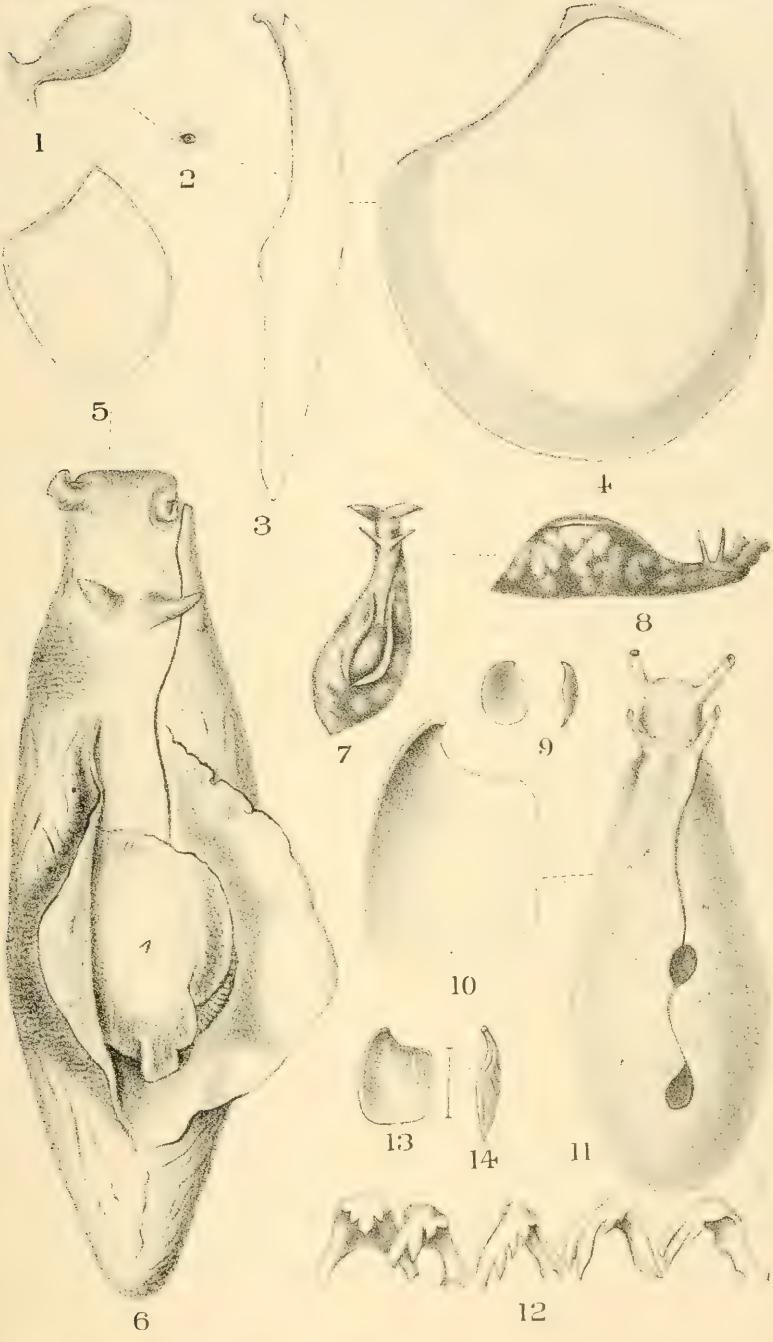
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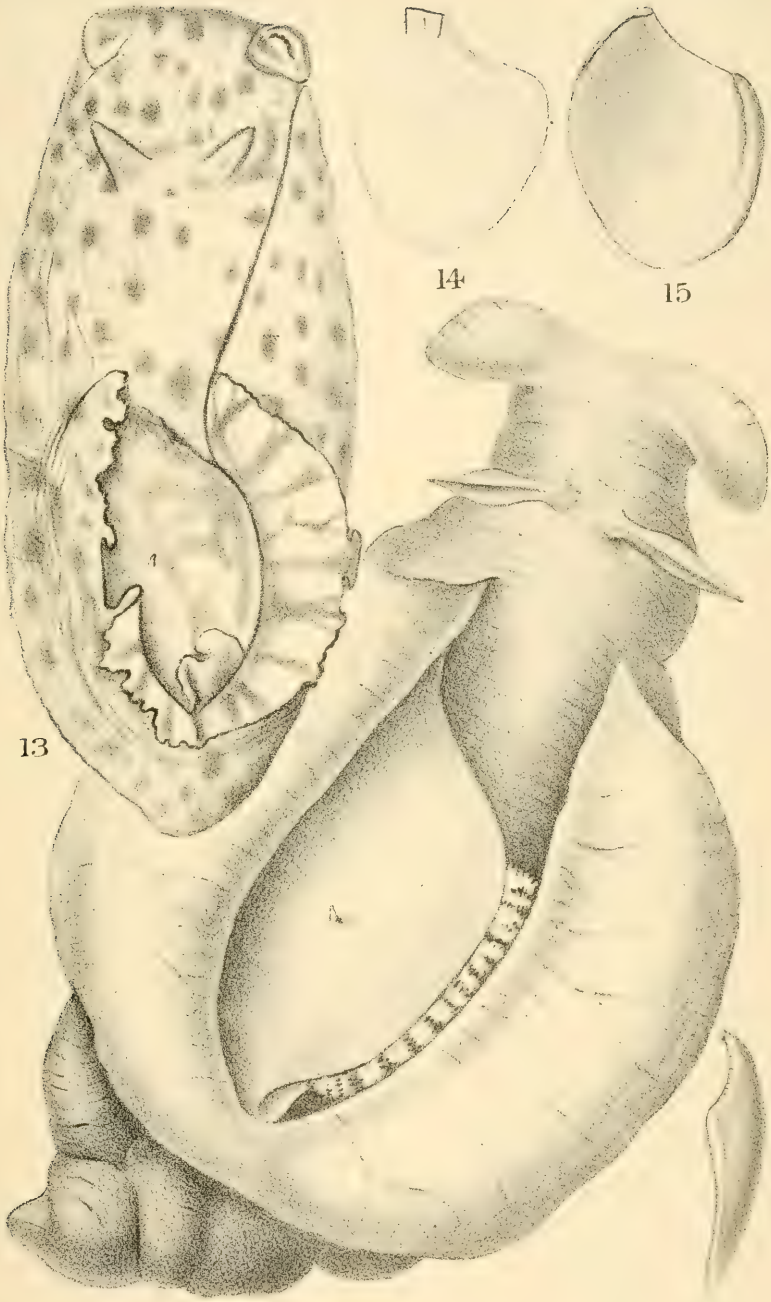
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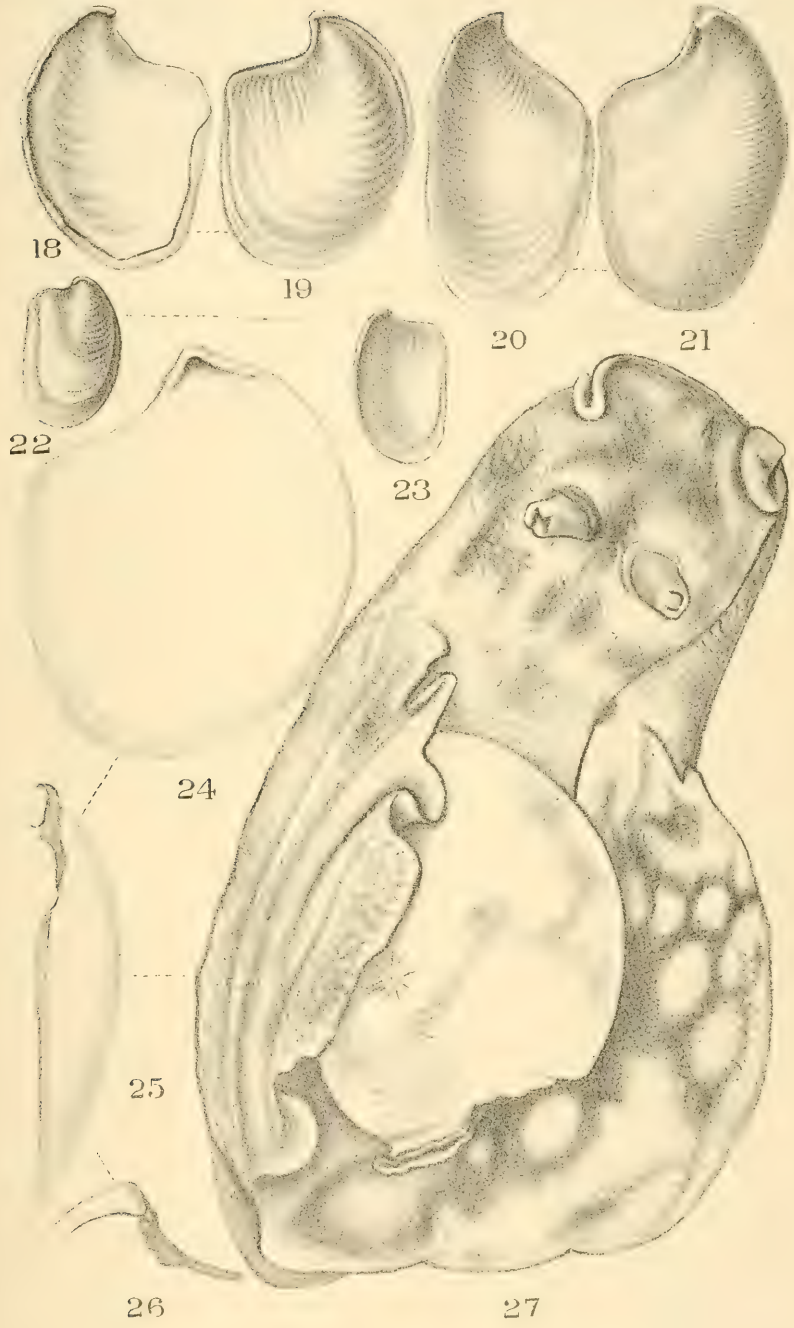
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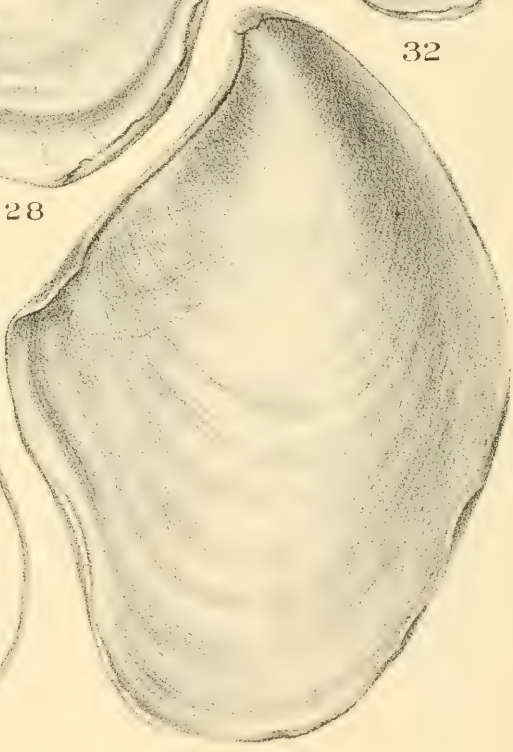

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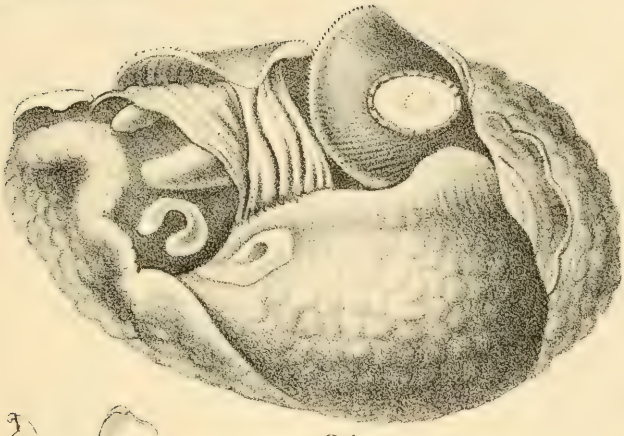

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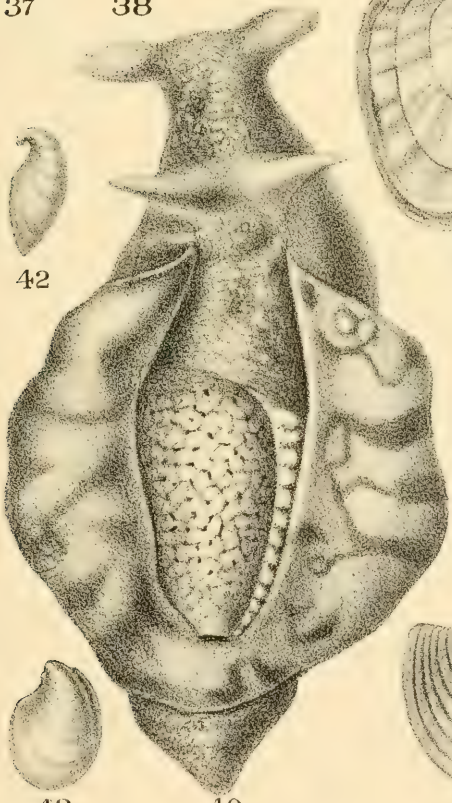

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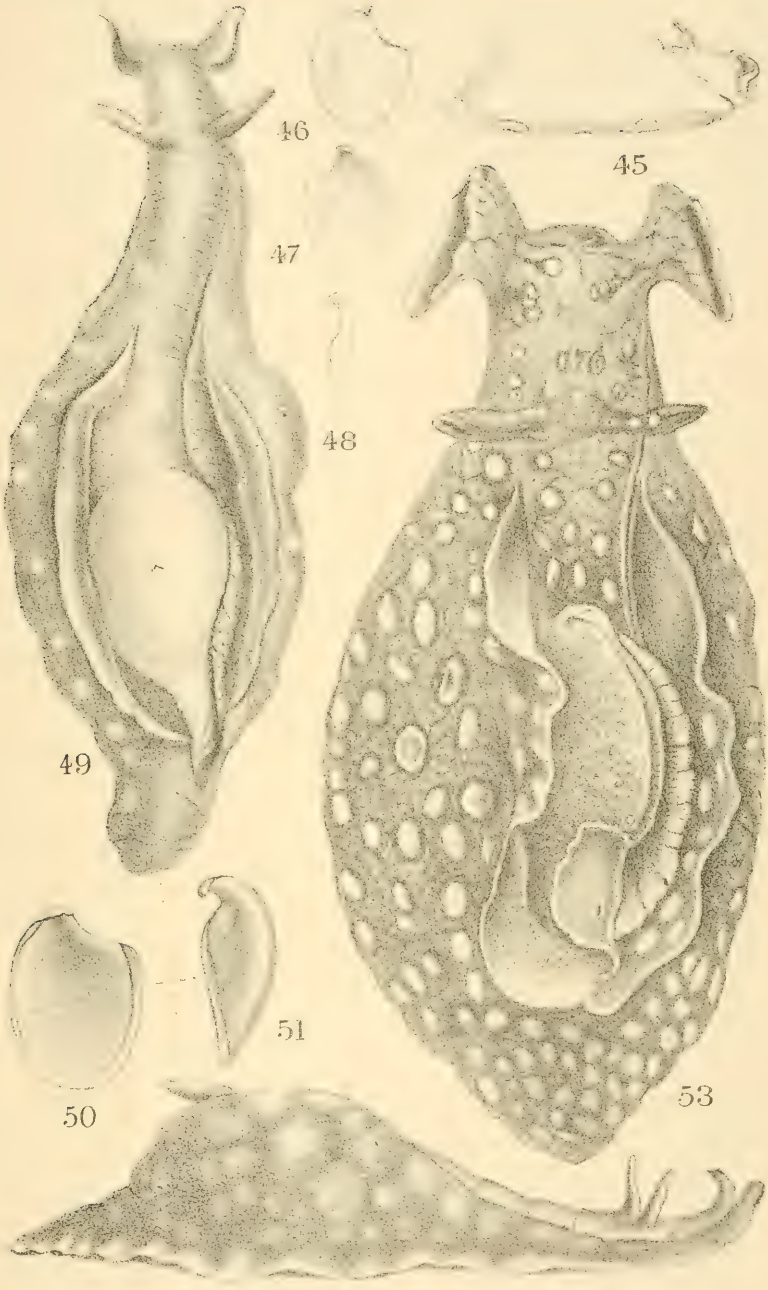
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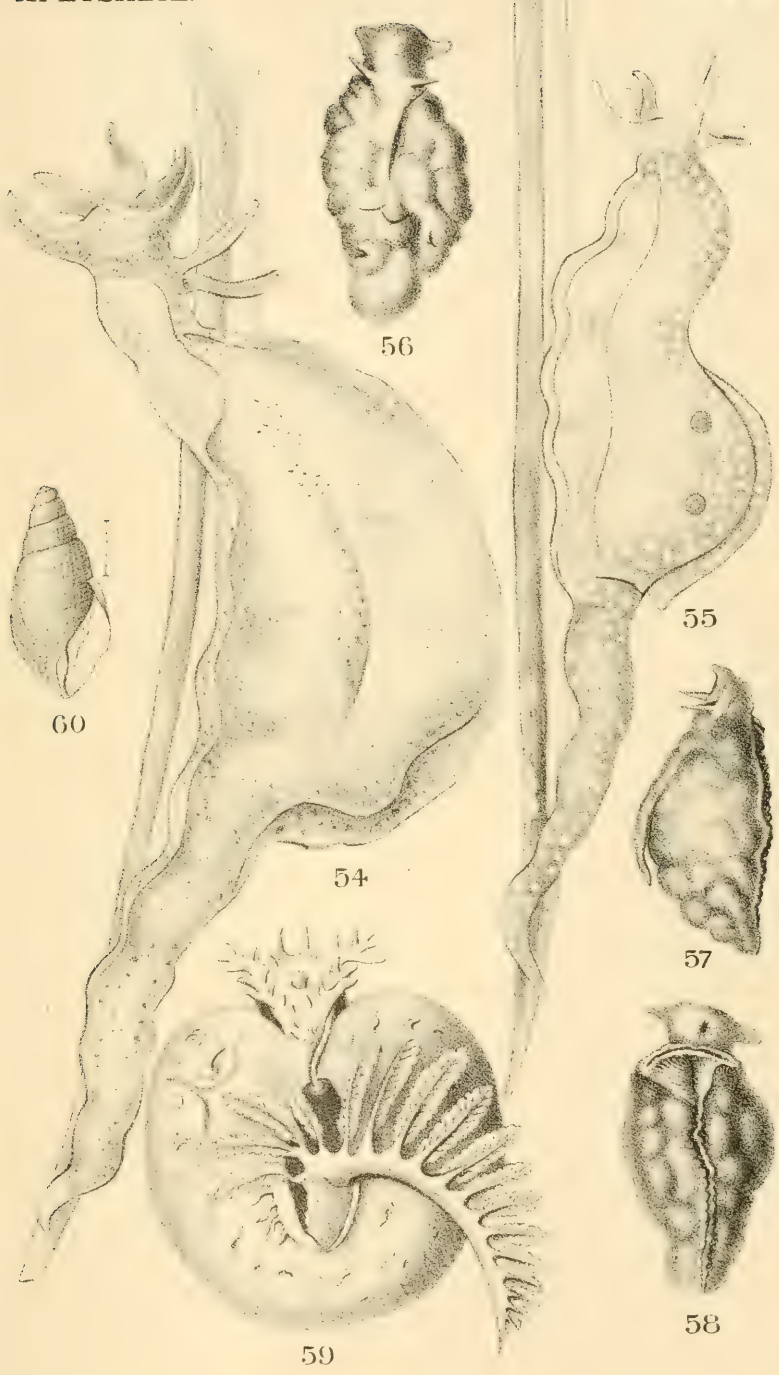

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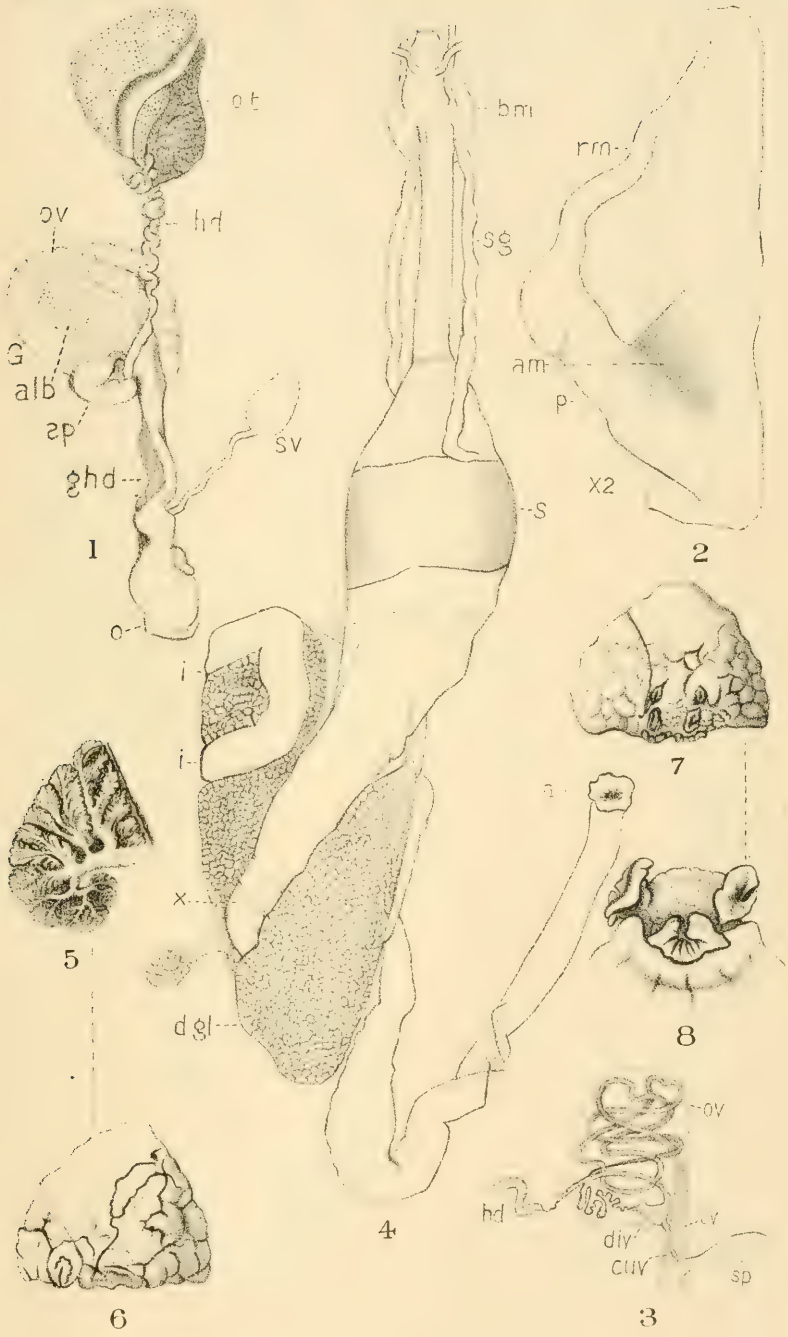
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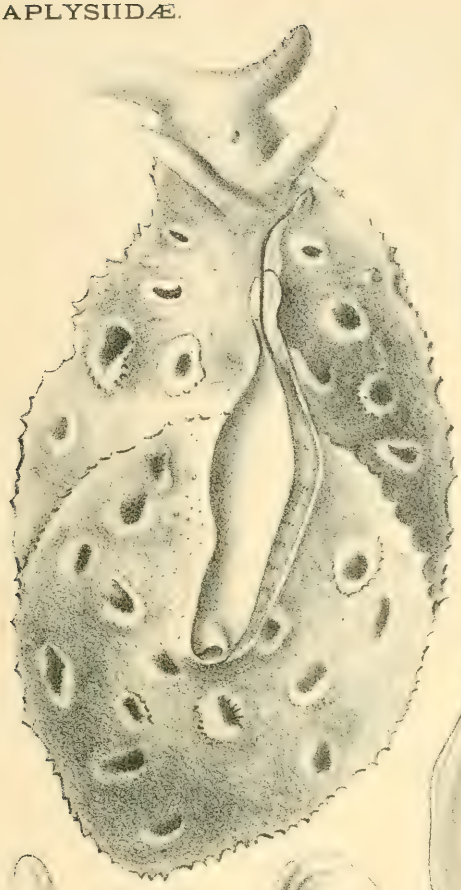

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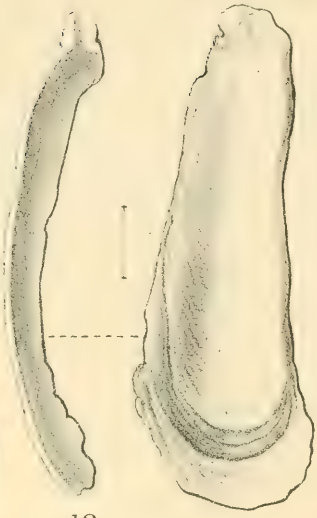

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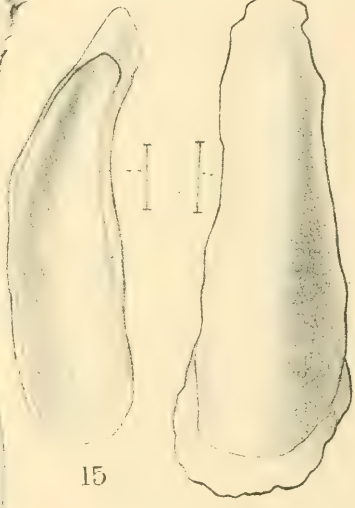

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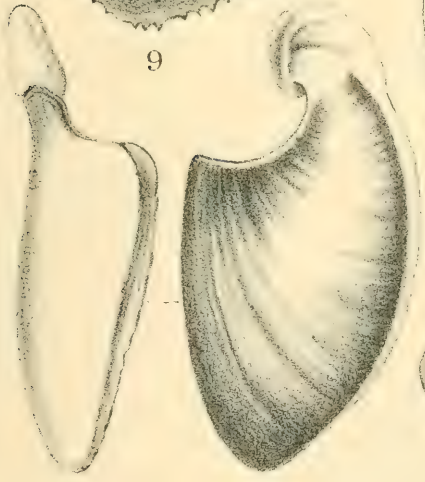

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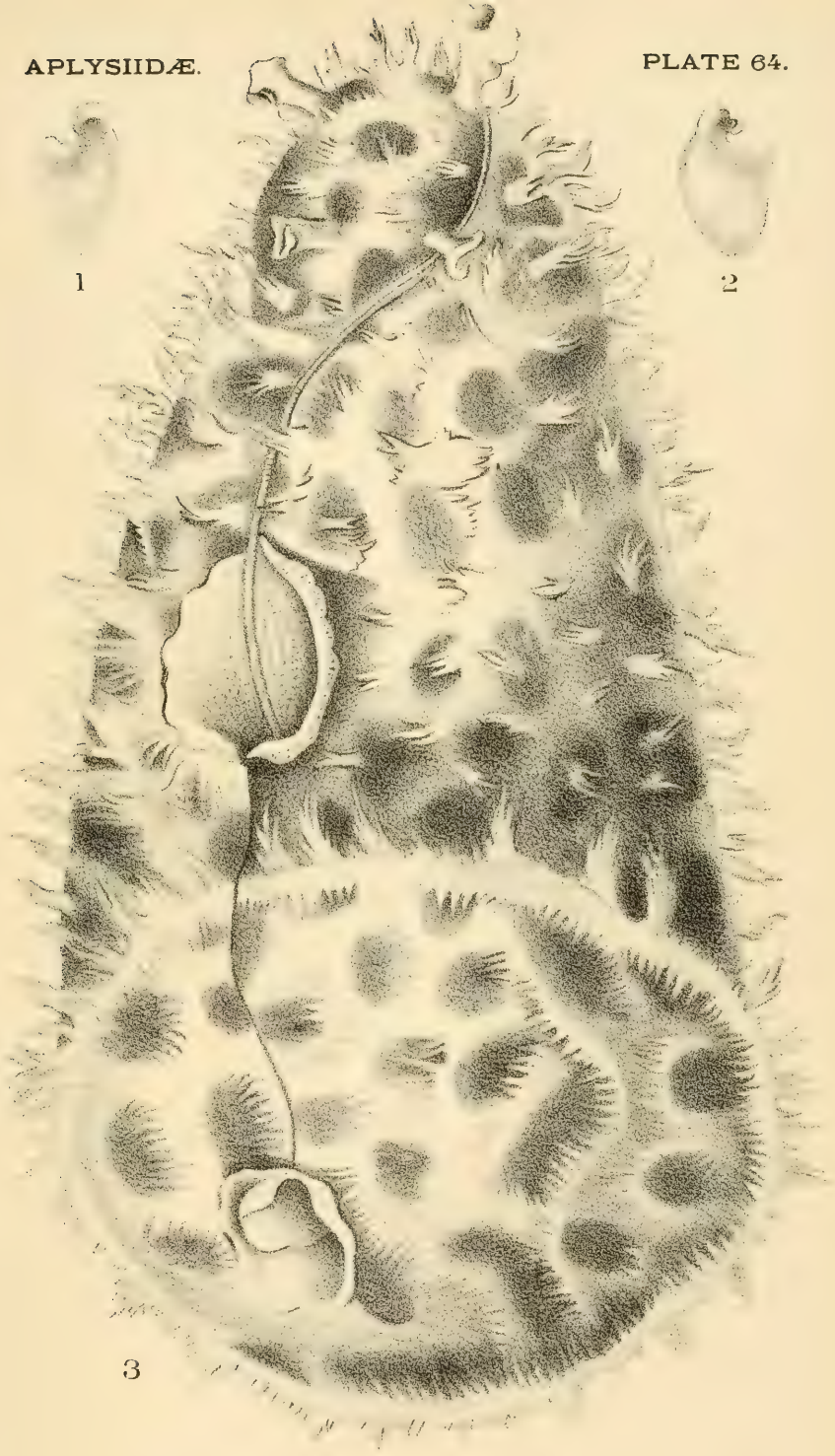

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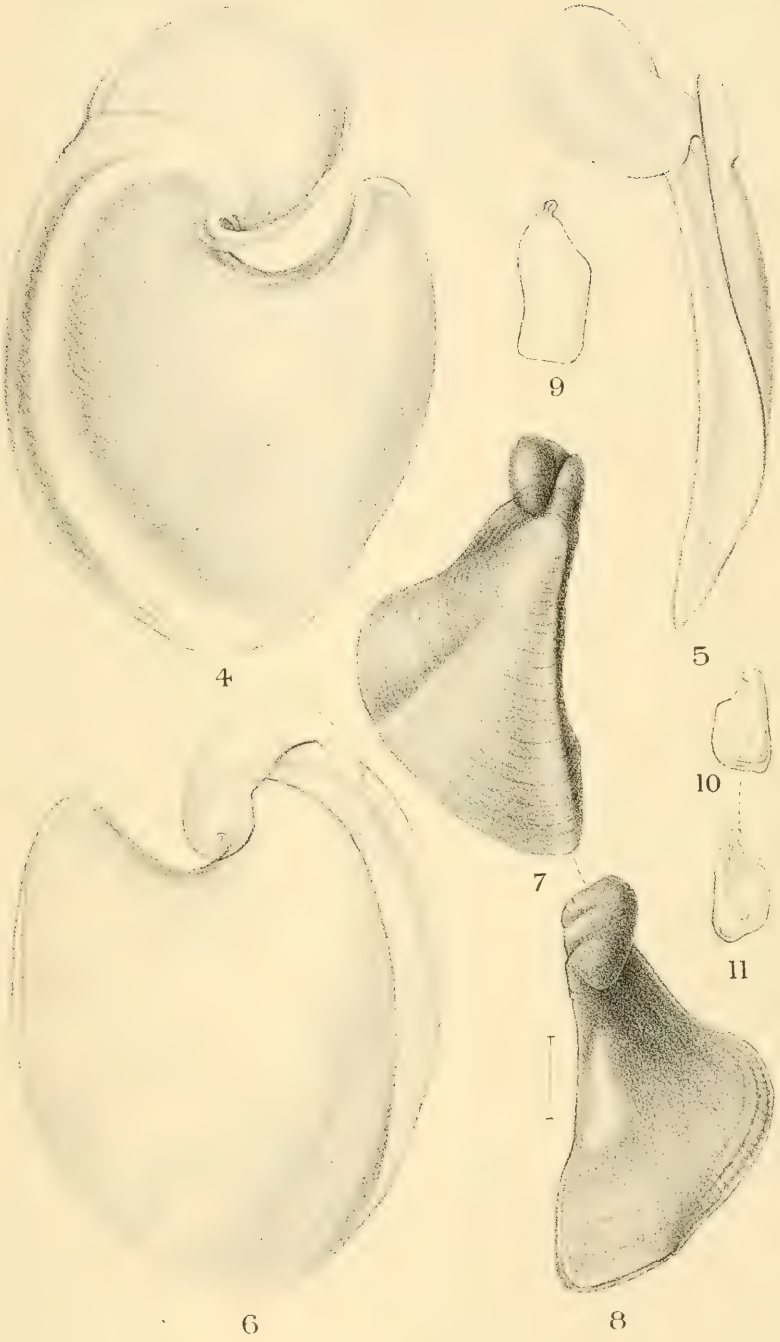
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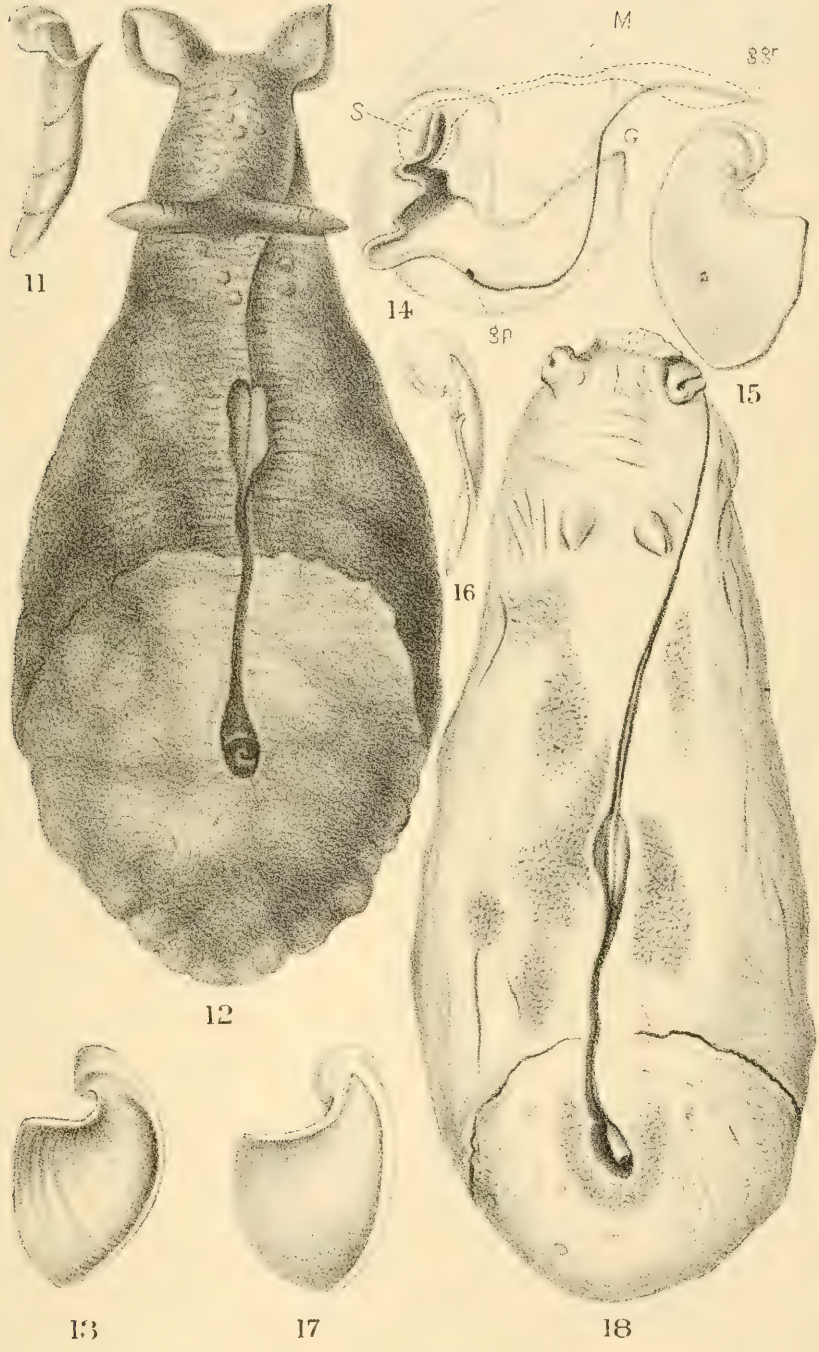

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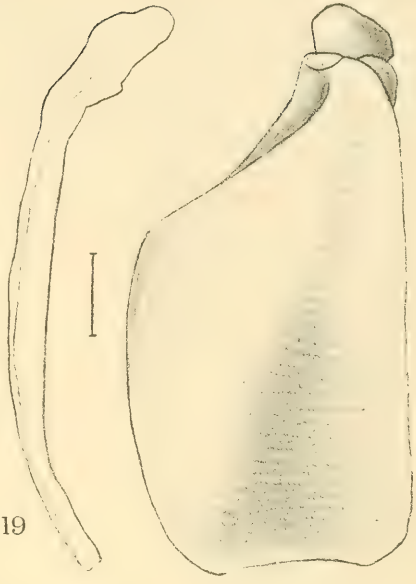

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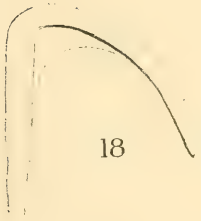

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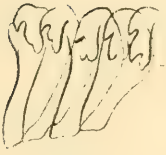

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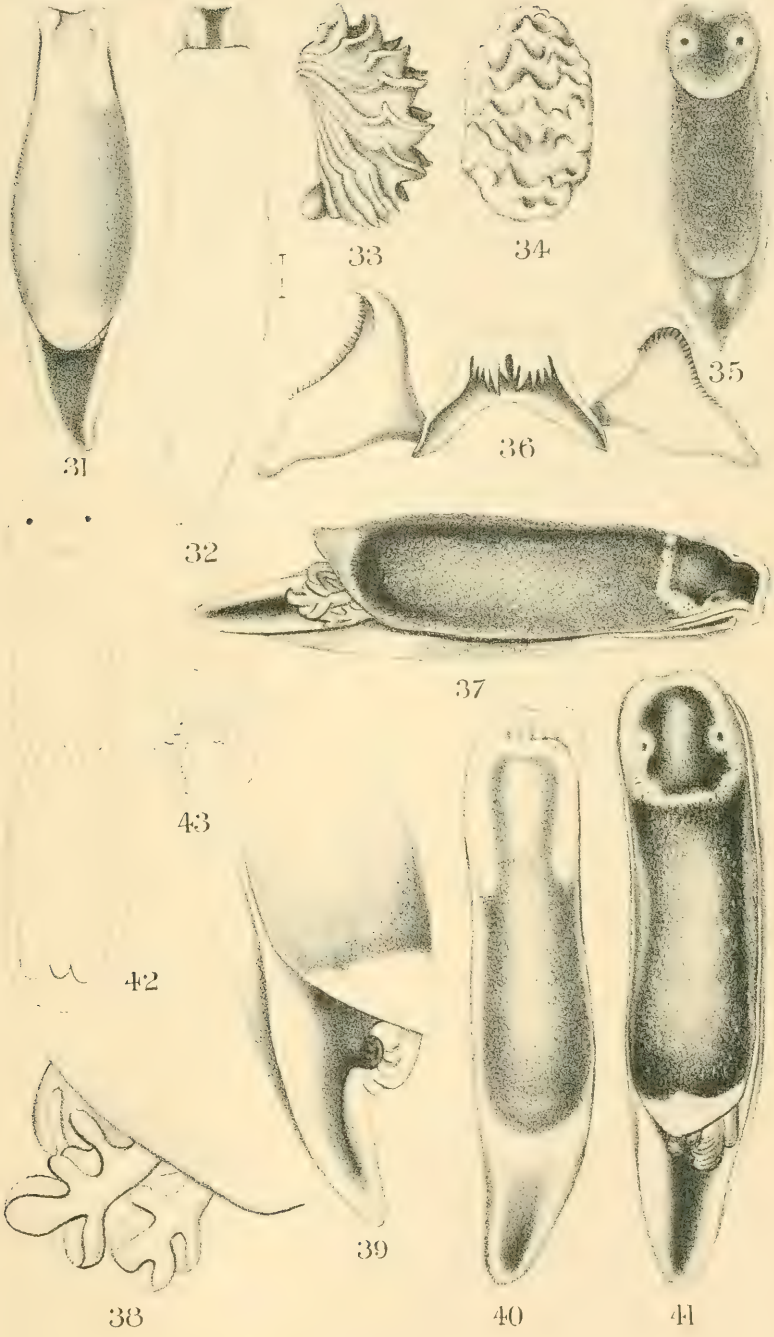
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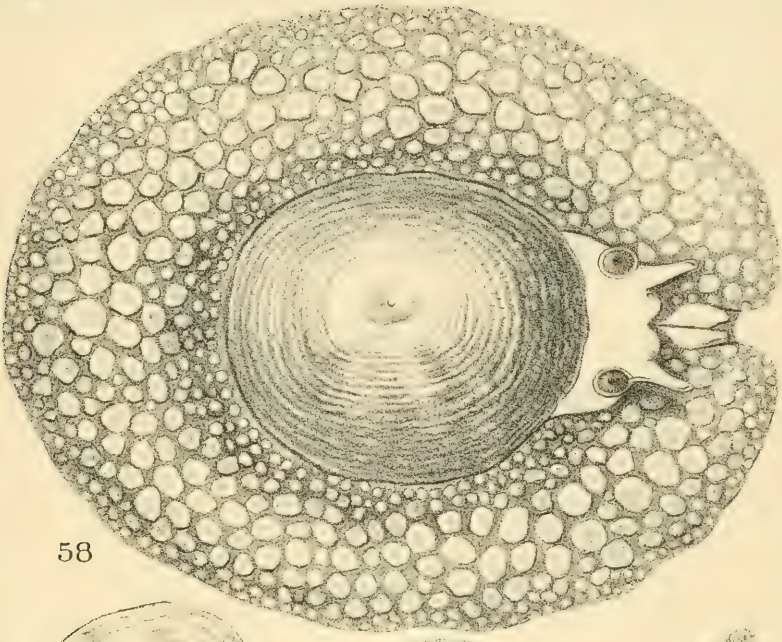

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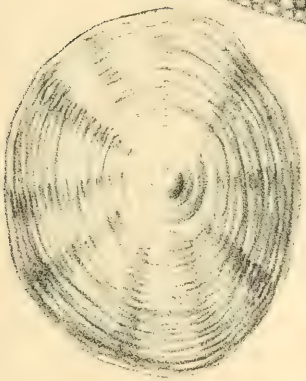

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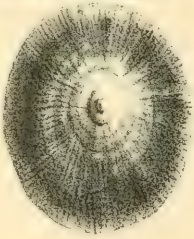

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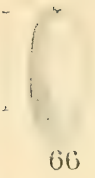

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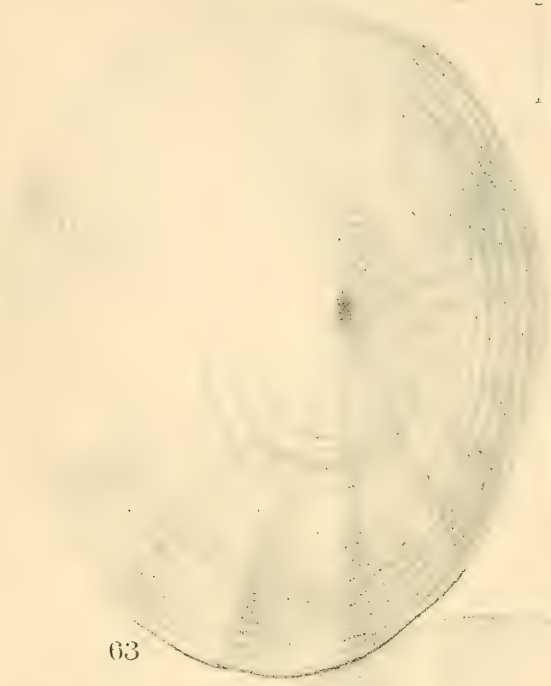

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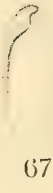

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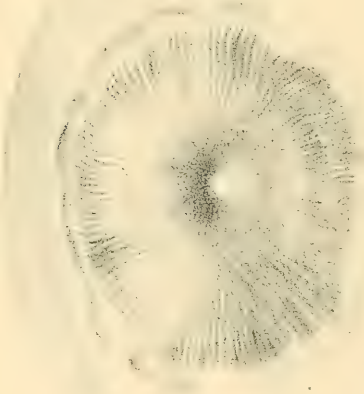

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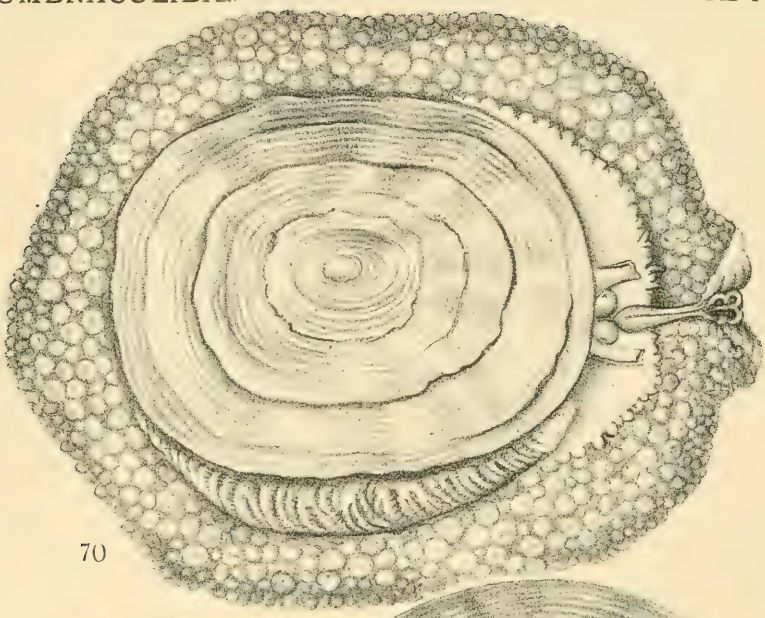

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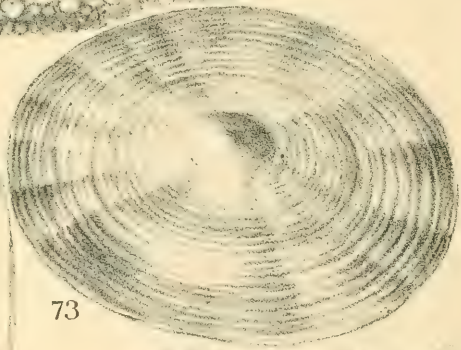

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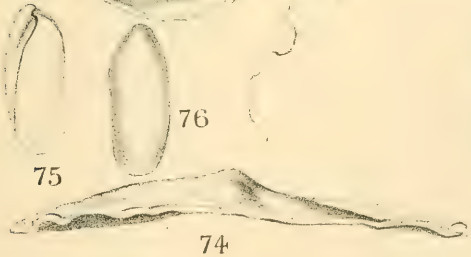

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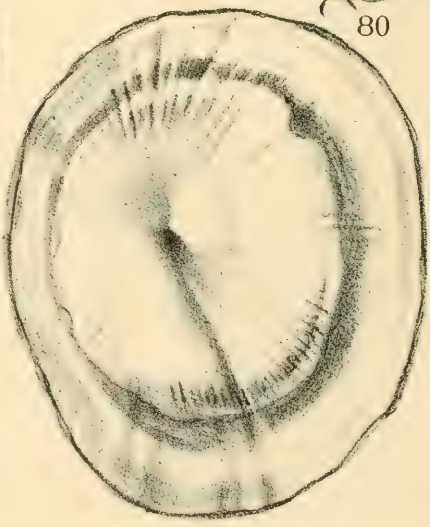

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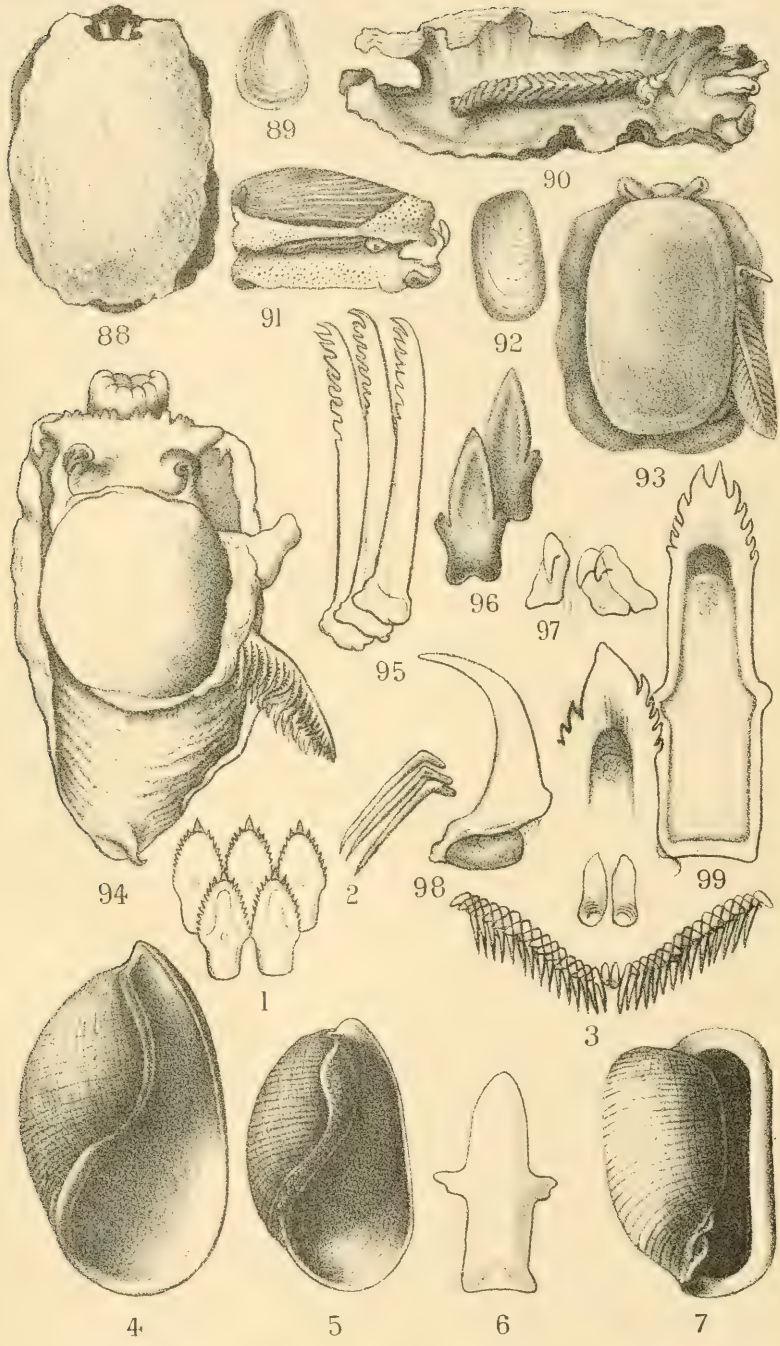
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